proceedings of the

surface protection seminar

theme: travel and transportation practices to prevent surface destruction in the northern environment

January 19-22, 1976

Anchorage, Alaska

U. S. Department of the Interior

Bureau of Land Management

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SURFACE PROTECTION SEMINAR

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A few presentations have been omitted because neither a paper nor a suitable recording was available. Printing limitations made it impossible to reproduce color slides used by many participants in their seminar presentations.

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introduction

From an historical point of view, human occupation has operated chiefly to harm the landscape, not to preserve it. In the past there were always new opportunities beyond the frontier for those men who had worn out their landscape or, in the modern vernacular, "degraded their environment."

We now find that there are no more frontiers and that the limits of the earth are finite. Man is moving into the least hospitable areas of the globe and causing the desert to bloom and the tundra to bring forth oil. Once called "Seward's icebox" and thought to be a barren wasteland, Alaska is yielding her riches to the nation in ever-increasing variety as advancing technology provides means to cross the tundra, traverse mountain ranges, and bridge wilderness rivers. But at what cost?

Modern technology gives man the ability to cause drastic changes in the landscape. This situation is dangerous because the ability to make specific changes is not balanced by an equal ability to predict or control other unwanted and damaging changes that occur as inadvertent and unforeseen consequences of specific actions. Ability to plan and create monumental projects carries with it the likelihood of making monumental mistakes.

Each technological triumph changes the face of Alaska; game trails and dog sled trails have become highways, remote scrub forests have been pushed aside to make landing strips, dust devils dance in gravel pits, and scattered among the tiny, bright wild-flowers of the north is man's litter. The rusty 55 gallon gasoline barrel is wryly referred to as a "tundra blossom" and "the Alaska state flower."

As the tracks of technological progress increase on the Alaskan scene, so has the awareness of some people that man need not deface the earth in order to enjoy the bounty of nature's resources. While many of the industrial vanguard were insensitive and uncaring, others have been searching for methods of travel and resource extraction that would rest lightly upon the landscape.

With these problems and opportunities in mind, the Bureau of Land Management convened this surface protection seminar as a means of discussing the range of disturbances and sharing knowledge among interested individuals from government, industry, and citizen groups. As a unifying theme for the diversity of invited speakers, we chose: "travel and transportation practices to prevent surface destruction in the northern environment."

The four-day seminar was held in Anchorage in January 1976, and more than 50 experts in a wide range of fields addressed an audience of about 350 persons. The nine seminar sessions were divided roughly into two broad categories: surface disturbance and surface protection. These proceedings follow the same format as the seminar.

This is the first attempt in Alaska to bring together the most recent knowledge on the very broad subject of surface protection, and we hope that by publishing the proceedings we can make that knowledge available to an ever larger audience. We are also hopeful that the information contained here will encourage greater respect for the sensitivity to disturbance of our northern ecosystems and foster an active concern for the health of the land.

--Dr. H. William Gabriel, Chief
Branch of Biological Resources
Bureau of Land Management
Alaska State Office

session one

CHAIRMAN: Curtis V. McVee, State Director
Bureau of Land Management
Alaska State Office
Anchorage, Alaska

Keynote address–

Bureau of Land Management Responsibilities to Prevent Surface Damages During Use of National Resource Lands

Curtis V. McVee

ABSTRACT
The Bureau of Land Management's role in surface protection in Alaska began in the late 1950's when fire lines were built to protect property and showed the relation between such activity and surface disturbance. The application for the oil pipeline opened the way for new studies, while development and accelerated use of off-road vehicles have contributed to surface disturbance problems and need for study and regulation, both for prevention and rehabilitation. It is hoped that information shared during the Surface Protection Seminar will help establish regulatory standards and procedures, develop guidelines, promote cooperation among agencies, and suggest research needs.

Maybe the term surface protection is new or awkward to you, and you know the subject by other names, such as soil conservation or watershed protection. Yet, I believe we are all thinking and talking about the same problem.

I have tried my pen at a definition of surface protection, and it came out like this: The integrated application of engineering and biological skills to prevent damage to and reclaim lands used by man. While this definition probably leaves much to be desired, by the end of the week, after hearing all the excellent speakers on the program, I should be able to write a better one.

While most of us think of a wheeled or track-type motorized vehicle as the culprit, we can all think of instances where man, without much help from a machine, made an adverse impact upon plant life and the soil regime which resulted in accelerated hydrologic or thermal erosion. With the help of simple tools, such as pulaski and shovel, this impact is compounded. Add ATV's or a dozer, and the potential exists to multiply many times what man can damage.

The effects of man's use or extraction of resources is not a newly discovered problem, but rather one that has needed attention of managers and scientists for some time. Only a small number of people appreciate this problem as it affects the Arctic and Subarctic--most of them are in this room.

Early mining activities, beginning before 1900 and including the work of individual miners as well as large dredges, left their mark upon Alaska. The effects of military projects, particularly those of World War II vintage, are still apparent. Winter roads and trails, many now called historic, left their marks, as have oil and gas exploration activities.

My concern is that technology developing at a geometric rate carries with it the potential to accelerate destruction of land. This, coupled with time and money for people to spend in recreational pursuits, such as purchase of ORV's, and increased mobility of our population, makes it <u>imperative</u> that we--land manager or land user--concern ourselves with surface protection.

Here are some significant highlights in the history of BLM's surface protection program in Alaska.

1. In the late 1950's during a season of disastrous wildfires, BLM began using dozers to build fire lines to protect valuable timberland and private property close to Fairbanks. This was our first exposure to BLM-induced surface damage; it made us acutely aware of the delicate temperature, soil, and moisture balance. I have inspected most of these old fire lines as well as many newer ones, as have people who have much more expertise than I do. Many of these have reclaimed themselves naturally and some of them are continuing to erode and cause destruction of the land and siltation of streams.

2. In 1969 Trans-Alaska Pipeline Company (TAP), predecessor to Alyeska, filed an application for an oil pipeline. This has contributed to our knowledge more than any other action by concentrating the collective minds of industry, government, and the scientific community on the problem of surface protection.

3. About 1970, Jerry Hok, then of the University of Alaska, spent a summer with BLM, compiling data on the North Slope. He did an inventory of all the old trails, winter and summer, on the Slope. This further defined the problem and convinced us there were some simple do's and don'ts, although the efforts identified more problems than solutions.

4. In 1971, we initiated a study aimed at defining the problem of managing permafrost soils and from this study generated a policy statement to serve as guidance for the Bureau in Alaska.

No one agency can take credit for collecting all the existing knowledge on the subject. This is obvious if you look at our seminar program and the variety of speakers who will be making contributions during the next four days. The problems identified here will become the collective property of all concerned and our responsibility to resolve. Similarly, solutions will be common property to apply.

How does BLM manage the public lands within its defined statutory and regulatory responsibilities to mitigate surface damage?

1. Through the development of standards and procedures applied to our own operation and to those of permittees or licensees who use the public lands.

2. Through the rehabilitation of areas which have been disturbed by surface use. I think we are generally better equipped with knowledge and ability to repair damage and rehabilitate areas disturbed by vehicle use than we are with an understanding on how to prevent this damage in the first place.

Bob Price will elaborate upon the legal aspects and some of the legal bases for management of the lands.

Increasing interest in exploration and development of natural resources in Alaska is leading to increasing off-road travel and subsequent damage to vegetation. The energy crunch and the interest in developing some of the energy reserves in Alaska are compounding this problem.

Most visible to the airplane traveler are the oil and gas seismic lines. While these may not damage resources or cause erosion, they have visual impact and <u>may not</u> be esthetically pleasing in an expanse of unmarred virgin wilderness.

Access trails to cabins, hunting areas, fires, and mining claims have been recognized in given situations as contributors to surface damage that has resulted in soil erosion and stream siltation.

In some areas--such as the Denali Highway--hunters using ATV's and ORV's have caused the type of disturbance normally associated with development activities. This type of use has grown enormously, and the variety of vehicles has proliferated greatly over the past 10 to 15 years. We used to think of recreational off-road vehicles in terms of four-wheel drive vehicles or motorcycles. But now there is a vast array of tracked, multiwheel drive, and soft-tired vehicles. Even surplus tanks have been used to carry moose meat home from the hunt.

An unwanted side effect of the increasing use of ATV/ORV's by recreation users is the unsightly scars and eroded surfaces they create. Another problem is conflict between motorized and nonmotorized recreation users.

Public Outcry Over Observed Damages

BLM has been publicly chastised in various newspapers, magazines, and conservation group newsletters for allowing certain situations to occur. Here are some examples:

- Kantishna area mining claim access trails
- Steese Highway area mining access trails
- Tangle Lakes archeological area, where we have been charged with "destruction by neglect" because use of recreation ORV's is not regulated
- Denali Highway hunter and general recreation trails
- Campbell Airstrip Tract--conflict with dog mushers, snow machine users, and skiers

Some of these are a legal problem, some a management problem. All have technical implications and impact on the soil-vegetation-animal complex.

The USDI issued regulations for ORV use on public lands in 1974 and these generally permitted use everywhere. The National Wildlife Federation sued, and the court held that regulations were invalid because designation of all public lands as open to ORV's was not in conformity with Executive Order 11644 which required that lands be identified as open or closed to off-road vehicle use. Regulations now are being revised.

What is BLM Doing about the Problem?

We have revised our policy on forest fire control, the location of fire control lines, and the method of their construction. A soils or other natural resource specialist now participates in decisions on line location and inspects lines for rehabilitation needs before crews and

equipment are moved from the fire line.

Other steps BLM has taken to control surface damage follows:

- Promulgated Campbell Tract regulations to zone recreation use
- Initiated a study this summer (1976) under contract with Colorado State University on ORV use along the Denali Highway
- Is working with the Alaska Miners Association to develop "specifications" and standards to be used as a guide by miners
- Organized a coordinating committee with other d-2 agencies to review actions affecting d-2 lands. (D-2 lands are public lands identified under Section 17(d)(2) of Alaska Native Claims Act. Public Law 92-203.)
- Is holding this seminar to determine the "state of the art" at this time

We, however, still find ourselves applying a double, or maybe even a triple, standard. An applicant for a right-of-way under the 1920 Mineral Leasing Act can anticipate that a set of rigid guidelines and specifications will be attached to his grant or permit. Failure to follow these requirements results in forfeiture of bonds, cancellation of the authorization, and other legal actions. The recreationist or prospector with an ORV does not have to acquire permission before entering on public lands. Although some laws have been modernized to reflect the environmental ethic, others exist from a prior era.

We hope to resolve this dilemma. Basically, this seminar is a starting point to help us define the problem, identify sources of information, exchange ideas, and hopefully come up with some solutions.

<u>What do we expect from this Seminar?</u>

Here are some goals we hope to achieve:

- Establish a basis for developing realistic standards and procedures for <u>all-season</u> operations for <u>all persons</u> wanting to take part in any type of activity or use of public lands to prevent surface damages in the future
- Develop a comprehensive set of "specifications" which can be used to cover the spectrum of situations in Alaska
- Promote agreement and continuity among land management agencies

in issuing permits for travel and transportation across public lands

- Suggest research needs for the development of methods, practices, and equipment to prevent future surface damages

We have a diverse group of users in Alaska, making it very difficult to meet the needs and desires of all. For example, a geologist on a seismic line may also be a recreationist on a snow machine.

I would suggest we continue to work cooperatively to define standards, prepare land use stipulations, and establish priorities. I am concerned about maintaining the proper balance between land use and land use stipulations. I am also concerned about developing standards which are realistic and will provide the degree of protection to the resource necessary to perpetuate its production and use. I am concerned about the imposition of different local standards to different classes of the using public.

I am confident that this seminar is going to benefit BLM, and I hope it will be of benefit to all those who attend and participate.

Federal Law of Surface Protection of the Public Lands

Robert E. Price

ABSTRACT
In this discussion a legal overview is made of the basis of federal statutes pertaining to surface disturbance to demonstrate their limits and problems which might arise in their enforcement. It covers federal law only--not state law--and is restricted to those laws affecting public lands. The discussion does not cover proposed legislative or regulatory solutions to the problems which arise under existent law, except to emphasize present law, since Congress has not acted on such matters as the BLM Organic Act. Major topics considered are the following: 1. Federal constitutional basis; 2. The National Environmental Policy Act; 3. Federal statutes and regulations which regulate mineral disposal; 4. Rights of access; 5. Sanctions for noncompliance with federal surface protection requirements; and 6. The "taking" issue.

1. Federal Constitutional Basis[1]

[1]See Jurisdiction over Federal Areas within the States, Report of the Interdepartmental Committee for the Study of Jurisdiction over Federal Areas within the States, Part I: The Facts and Committee Recommendations, GPO April, 1956, and Part II: A Text of the Law of Legislative Jurisdiction, GPO June, 1957; Federal Legislative Jurisdiction, Report prepared for the Public Land Law Review Commission by the United States Department of Justice, 1969.

A. Property Clause

The "property clause" of the U. S. Constitution is the source of the authority of Congress to enact laws dealing with federal lands. This clause is found in Article IV, section 3, clause 2, of the Constitution and provides: "The Congress shall have power to dispose of and make all needful Rules and Regulations respecting the Territory or other property belonging to the United States...." It is only legislation based on the property clause that I will discuss today, but I will briefly mention other constitutional bases for other statutes in order to emphasize the differences in authority for the public land statutes.

B. Legislative Jurisdiction

Article I, section 8, clause 17, of the Constitution provides that the Congress has exclusive legislative jurisdiction over the District of Columbia and like authority over all places acquired by the federal government, with the consent of the state involved, for various federal purposes. It is the second type of property that presents certain problems with the states on questions of jurisdiction. The past practice has been for states to enact statutes consenting to the acquisition by the federal government of land within the state. More recently, certain states have enacted statutes making a cession of jurisdiction to the federal government. A third means for the acquisition of legislative jurisdiction by the federal government is a reservation of jurisdiction over certain areas in the state-enabling acts.

The federal legislative jurisdiction characterized as "exclusive" means that the federal government has all of the authority of the state within an area, with no reservation made to the state except for the right to serve process resulting from activities which occur off the land involved. "Concurrent" legislative jurisdiction applies in those instances wherein in granting to the United States authority, which would otherwise amount to exclusive legislative jurisdiction over an area, the state concerned has reserved to itself the right to exercise, concurrently with the United States, all of the same authority. "Partial" legislative jurisdiction is applied where the state has reserved to itself the authority, by itself or concurrently with the United States, to do more than serve process in the area; for example, the right to tax private property.

By way of illustration of these types of jurisdiction, the situation in Alaska is as follows: Section 11(a) of the Statehood Act provides that in Mount McKinley National Park there is "exclusive jurisdiction" in the federal government and reserves to the State of Alaska the right to serve process and the right to tax persons and corporations in the park. This is technically described as "partial" legislative jurisdiction. Therefore, state legislation, with limited federal statutory exceptions, is inapplicable in Mount McKinley Park. This is the only area of this type of jurisdiction in Alaska. Section 11(b) of the Statehood Act reserved to the United States "the power of exclusive legislation" over

those lands held for military, Naval, Air Force, or Coast Guard purposes, including NPR 4, at the time of Statehood, with three provisos: (1) service of process by the State; (2) the State may exercise "concurrently" with the United States jurisdiction over the lands as long as its exercise is "consistent with the laws hereafter enacted by Congress pursuant to such reservation of authority;" and (3) the federal power of exclusive legislation remains only as long as the land is owned by the United States and is used for military, Naval, Air Force, or Coast Guard purposes. This is technically described as "concurrent jurisdiction." Mobil Oil Corporation v. Local Boundary Commission, 518 P. 2d 92, 99 (Alaska 1974) upheld the inclusion of NPR 4 in the North Slope Borough on the basis that the state had concurrent jurisdiction over NPR 4.

The Assimilative Crimes Act, 18 U.S.C. 13, 7 adopts for places under "the exclusive or concurrent jurisdiction" of the United States, as federal law, the criminal laws of the host states defining crimes not made punishable by any act of Congress. The first legislation of this type was enacted in 1825, 4 Stat. 115, and was necessary because there was no applicable criminal law in such areas, except for certain serious crimes covered by the Federal Crimes Act of 1790, 1 Stat. 112.

C. Proprietorial Interest

The term "proprietorial interest" is used in those instances when the federal government has acquired some right or title to an area in a state but has not obtained any measure of the state's jurisdiction over the area. In Alaska, this means that the federal government has a proprietorial interest only in all of the lands owned by the United States within the state--except for Mount McKinley National Park and the military reservations discussed earlier. The laws relating to surface protection that I am discussing today are based on the property clause of the United States Constitution. These laws deal only with the public lands that are dealt with in that particular legislation and do not intend to regulate activities off of these public lands.

There is a significant distinction to be made between these public land laws and the environmental protection type laws. The environmental laws, such as the Clean Air Act (42 U.S.C. 1857), the Federal Water Pollution Control Act (33 U.S.C. 1251), the Solid Waste Disposal Act (42 U.S.C. 3251), the Noise Control Act (42 U.S.C. 4901), and the Federal Insecticide, Fungicide, and Rodenticide Act (7 U.S.C. 136), apply irrespective of the land status. Their constitutional basis is not the property clause but the commerce clause insofar as they regulate the activities of persons off of federal lands.[2] Article I, section 8, clause 3

[2]See Rosenthal, The Federal Power to Protect the Environment: Available Devices to Compel or Induce Desired Conduct, 45 Southern California Law Review 397 (1972). See Soper, The Constitutional Framework of Environmental Law in Federal Environmental Law, Environmental Law Institute (1974), pp. 20-125.

grants to Congress the power "To regulate Commerce...among the several States...." The commerce power has been broadly construed by the courts to sustain environmental protection laws even though the effect on interstate commerce is quite remote.

D. Preemption[3]

A preemption problem arises when a state or local government attempts to regulate an activity which is also regulated by federal statute. The U. S. Supreme Court has rendered recent decisions on preemption problems which have arisen in the environmental law context but there are no such decisions directly in point under the federal mineral disposal statutes. There is, however, present interest in this aspect of the preemption problem, and I think that the subject is worth some of your time today.

The preemption doctrine has its basis in the supremacy clause of the U. S. Constitution, which is found in Article VI, clause 2, which provides in part: "This Constitution, and the Laws of the United States which shall be made in pursuance thereof...shall be the supreme Law of the Land...."

In applying the supremacy clause to subjects which have been regulated by Congress, the primary task of a court is to determine whether, under the circumstances of the case, a state "law stands as an obstacle to the accomplishment and execution of the full purposes and objectives of Congress." Hines v. Davidowitz, 312 U.S. 52, 66-67 (1941). This generalization was refined in Florida Avocado Growers v. Paul, 373 U.S. 132, 142 (1963) in this way: "The principle to be derived from our decisions is that federal regulation of a field of commerce should not be deemed preemptive of state regulatory power in the absence of persuasive reasons--either that the nature of the regulated subject matter permits no other conclusion, or that the Congress has unmistakably so ordained." Recent decisions of the U. S. Supreme Court have indicated an inclination to sustain state legislation unless there is a necessary conflict with federal law. See, for example, Goldstein v. California, 412 U.S. 546 (1973); Askew v. American Waterways Operators, 411 U.S. 325 (1973).

The question of federal preemption on the public lands of state laws which regulate matters also regulated by federal mineral disposal

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[3]See The Preemption Doctrine: Shifting Perspectives on Federalism and the Burger Court, 75 Columbia Law Review 623 (April 1975); Landstrom, State and Local Governmental Regulation of Private Land Using Activities on Federal Lands, Natural Resources Lawyer, Vol. VII, No. 1, pp. 77-85 (Winter 1974); Olsen, Surface Reclamation Regulations on Federal and Indian Mineral Leases and Permits, Rocky Mountain Mineral Law Institute, Proceedings of the Seventeenth Annual Institute (1972).

statutes has not been the subject of frequent court decisions. Many of the recently decided cases, however, have been in the environmental law field and it may be only a question of time before the states enact laws which provide for the regulation of activities on federal lands or begin the enforcement of already enacted statutes.

The first distinction to be made in federal land cases in which there is a supposed conflict with state law is whether the state has any jurisdiction to enact such legislation. This is a decision to be made before any discussion of preemption. I discussed this subject earlier on the question of legislative jurisdiction. In an area of exclusive legislative jurisdiction, such as Mount McKinley National Park, the state has no authority to enact statutes which are operative within the park, unless such law is expressly authorized in the Statehood Act or in other federal statutes.

Utah Power & Light Co. v. United States, 243 U.S. 389 (1917) was perhaps the first Supreme Court decision to construe the basic land disposal authority of the federal government. The question of preemption was never explicitly discussed, but the language of the decision is often cited as general authority in that area. The case involved a suit by the United States to enjoin the continued occupancy and use, without its permission, of lands within forest reservations in Utah as electric power sites. The court enjoined the occupancy and awarded damages to the United States. Justice Van Devanter, at p. 405, stated:

> "And so we are of opinion that the inclusion within a state of lands of the United States does not take from Congress the power to control their occupancy and use, to protect them from trespass and injury, and to prescribe the conditions upon which others may obtain rights in them, even though this may involve the exercise in some measure of what commonly is known as the police power. 'A different rule,' as was said in Camfield v. United States, 167 U.S. 518, 42 L. ed. 260, 17 Sup. Ct. Rep. 864, 'would place the public domain of the United States completely at the mercy of state legislation.'"

The court was not faced with a serious preemption problem in the Utah Power case inasmuch as it only involved a question of whether a user of the public lands needed to comply with federal law to acquire an interest in the public lands.

Omaechevarria v. Idaho, 246 U.S. 343 (1918), was decided the following year by the Supreme Court, in an opinion by Justice Brandeis, and did involve a clear question of preemption. This was an action to review a conviction by the state court in Idaho of a defendant accused of grazing sheep on the public lands in Idaho in violation of a state statute which disallowed such grazing on a range previously occupied by cattle. This was before the enactment of the Taylor Grazing Act in 1934, see 43 U.S.C.

315 et seq., and there were no federal grazing regulations. The only relevant federal statute was the Unlawful Enclosures Act, the act of February 25, 1885 (43 U.S.C. 1061 et seq.). The court upheld the Idaho statute in this language, at p. 346: "The police power of the state extends over the Federal public domain; at least, when there is no legislation by Congress on the subject." Justice Brandeis found no conflict between the Unlawful Enclosures Act and the Idaho Statute after a close analysis of the two statutes. He reasoned that the state could regulate grazing on the public lands because this grazing was not a matter of federal statutory right but by sufferance of the federal government. It is of interest to note that Justice Van Devanter, the author of the Utah Power decision which found preemption, dissented in the Omaechevarria case.

There is one other federal decision which discusses preemption under the mineral disposal statutes. Texas Oil & Gas Corp. v. Phillips Petroleum Company, 277 F. Supp. 366 (W.D. Okla. 1967), aff'd., 406 F. 2d 1303 (10th Cir. 1969) cert. denied, 396 U.S. 829 (1970), was a suit by owners of oil and gas leases on federal lands in Oklahoma, requesting that their title in lands be quieted by declaring a forced pooling order of Oklahoma Corporation Commission to be void. The court held that there was no federal preemption under the Mineral Leasing Act of 1920 of state conservation laws under the circumstances of that case. One of the principal reasons for that decision was the language of section 30 of the Mineral Leasing Act, 30 U.S.C. 187, which provides for lease provisions. It states in its final sentence: "None of such provisions shall be in conflict with the laws of the State in which the leased property is situated."

The court also relied on the language of section 32 of the Mineral Leasing Act, 30 U.S.C. 189, which provides: "Nothing in this chapter shall be construed or held to affect the rights of the States or other local authority to exercise any rights which they may have, including the right to levy and collect taxes upon improvements, output of mines, or other rights, property, or assets of any lessee of the United States."

The court also noted that there were the requisite federal approvals for assignment of interest and communization in the case.

The court, at p. 369, observed that state police power in this area of conservation could only attach after the satisfaction of these prerequisites. The Texas Oil & Gas Corp. case is consistent with the rationale of Solicitor's Opinion, M-36416, 64 I.D. 44 (1957), to the extent that it requires federal assent, but the Solicitor's Opinion arrived at a contrary result on the question of the applicability of state community property law under 30 U.S.C. 189. Ohmart v. Dennis, 196 N.W. 2d 181 (Neb. 1972), followed the Texas Oil & Gas Corp. case in a decision involving pooling under Nebraska law of a federal oil and gas lease and held that it was essential to have the approval of the Secretary of the Interior for state pooling orders.

These are the major federal decisions on preemption in public land law cases. There is, however, one state superior court decision which I will mention because it is an Alaskan case, State of Alaska v. Nelson, Case No. 74-42-CR (Superior Court, First Judicial District at Sitka). This was a criminal action brought against a logger for felling trees into a salmon-spawning creek in alleged violation of AS 16.10.010(1), which prohibited felling trees in salmon-spawning waters. The logging was being done in the Tongass National Forest pursuant to a U. S. Forest Service contract. The contract required clearcutting in the area in which was located the particular salmon-spawning creek, but separate contract provisions regulated the cutting of trees along streams. The court held that the Alaska statute could not be enforced under the circumstances of the case because it conflicted with the forest-management responsibilities of the Forest Service. The enforcement of the federal statute placed the logger "in the unenviable position of either complying with State law and thereby exposing himself to penalties for failing to comply with the federal management decisions embodied in his contract or complying with his federal contract and exposing himself to criminal liability at the hands of the state." (at p. 22). The judge implied in the decision that the state should attempt to attain its objective of the protection of salmon-spawning streams by direct suit against the Forest Service.

I believe the case illustrates quite clearly the preemption issue within surface protection. I suggest, however, that the case does not mean that a court will always find federal preemption of state fish and wildlife conservation legislation under the federal mineral disposal statutes. It is necessary to analyze closely the particular activity authorized or, as in the Nelson case, required by federal law, regulation, or contract to determine if there has been a preemption of state law.

I would like to close the discussion of preemption by pointing out at least one solution to the preemption problem which arises out of a conflict between the federal government and a state. This is the adoption by the federal government of state surface use controls for application on federal lands. The Public Land Law Review Commission recommended in its 1970 report that Congress enact legislation for that purpose and that, in the interim, federal administrators require adherence to state standards. See One-Third of the Nation's Land, Recommendation 17, p. 70. This is the procedure proposed by the Department of the Interior in Proposed Rulemaking for Coal Mining Operating Regulations. These proposed regulations were published September 5, 1975,[4] in the Federal Register, and hearings were held in several of the western states in December. The problems associated with strip mining of federal coal deposits in the western states has been and still is a controversial subject. It has resulted in a presidential veto on May 20, 1975, of H.R.

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[4]40 F.R. 41122.

25, a proposed Surface Mining Control and Reclamation Act of 1975, and this veto was sustained by the House on June 10.[5] I believe that one of the objectives of the Proposed Rulemaking for Coal Mining Operating Regulations is a partial resolution, insofar as federal lands are concerned, of the strip mining problems. Proposed Rule 43, CFR 3041.8, provides for the adoption by the Secretary of the Interior of state reclamation law as federal law when he determines that this would result in the protection of environmental values which is at least as stringent as would otherwise occur under exclusive application of federal controls and would be consistent with the interest of the United States in the timely and orderly development of its coal resources. There is a difference in approach here and in H.R. 25. Section 505 of H.R. 25 provided for the automatic applicability of state reclamation law whenever that state law was more stringent on land use and reclamation than federal law. This is, perhaps, one of the differences that led to the veto. I call this to your attention to emphasize the significance of the preemption doctrine.

2. The National Environmental Policy Act

The National Environmental Policy Act (NEPA), 42 U.S.C. 4321-4347, became effective on January 1, 1970. The environmental impact statements (EIS's) are familiar to all of you, and I will not discuss that part of NEPA. Instead, I would like to call to your attention other aspects of NEPA that relate to our considerations today on surface protection.

NEPA also established policies and goals for federal agencies which are to be considered in the implementation of other federal statutes. These environmental objectives are set out in the first sections of Title I of NEPA. See 42 U.S.C. 4321, 4331. NEPA also directed that "the policies, regulations, and public laws of the United States shall be interpreted and administered in accordance with the policies set forth in this chapter," see 42 U.S.C. 4332 (1), and also provided that the policies and goals of NEPA were "supplementary" to existing authorizations of federal agencies, see 42 U.S.C. 4335. See Union Oil Company v. Morton, 512 F. 2d 743, 749 (9th Cir. 1975).

Therefore, in matters of surface protection of the public lands, federal agencies have not only the authority but the obligation to consider NEPA policies for discretionary actions authorized under other statutes. I used the term "discretionary" deliberately because the Interior Board of Land Appeals has held that NEPA does not apply to nondiscretionary actions. United States v. Kosanke Sand Corporation, 12 IBLA 282 (1973), held that the Bureau of Land Management was not obliged to prepare an EIS before issuing a patent to a mining claim.

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[5]See 121 Cong. Rec. H 3650 (May 5, 1975) for Conference Report on H.R. 25; U.S. Code Cong. & Ad. News, No. 5, p. 786 (June 25, 1975) for veto message.

The approach of the Department of the Interior, however, in actions which do involve discretion, is the inclusion of surface protection stipulations in the particular approval document; for example, in the permit, right-of-way, or lease. The Interior Board of Land Appeals has upheld the inclusion of environmental stipulations in such documents. See, e.g., J. D. Archer, 2 IBLA 303 (1971). The best known illustrations of such stipulations are those included within the right-of-way grant under section 28 of the Mineral Leasing Act, 30 U.S.C. 185, for the trans-Alaska pipeline. I call to your attention the fact that all of the federal mineral disposal statutes, except of the Mining Law of 1872, 30 U.S.C. 21, 49a, which you will be discussing at this conference, are discretionary statutes.

3. Federal Statutes and Regulations which Regulate Mineral Disposal

I have set out for you in a footnote the pertinent statutes and regulations which regulate the disposal of mineral resources from the public lands. They are set out in their chronological order of enactment. I will not discuss comprehensively each of the statutes but instead will only note certain surface protection features of each.

The mining laws were first extended to the Territory of Alaska by section 8 of the Act of May 17, 1884, 23 Stat. 24.[6] The extension of the mining laws, which is presently in effect, is from the Act of June 6, 1900. See 30 U.S.C. 49a. The mining law that is thus made applicable was the Mining Law of 1872, 30 U.S.C. 21 - 54. The Mining Law of 1872[7] has its origin in the California Gold Rush and, it is the atmosphere of that era which helps to explain the operation of the mining laws today. Furthermore, the vast majority of claims staked in Alaska are still for gold. There are no surface protection restrictions in the mining laws. This is not, however, peculiar to the mining laws, as there are other public land disposal statutes, for example, the homestead laws, which also do not provide for surface restrictions. One of the consequences of this

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[6]See "Legal Aspects of Mineral Resources Exploitation" by Robert W. Svenson, pp. 699-765, in History of Public Land Law Development, Public Land Law Review Commission, 1968.

[7]Mineral Law of 1872 (30 U.S.C. 21, 49a) (43 CFR 3830, 3840);
Mineral Leasing Act of 1920 (30 U.S.C. 181 et seq.) (43 CFR 3109) (30 CFR 221) (30 CFR 211) (30 CFR 231);
Materials Act of 1947 (30 U.S.C. 601) (43 CFR 3600);
Mineral Leasing Act for Acquired Lands (1947) (30 U.S.C. 351-359);
Multiple Surface Use Act of 1955 (30 U.S.C. 611-615) (43 CFR 3710);
Surface Exploration, Mining and Reclamation of Lands (43 CFR 23);
Geophysical Exploration (43 CFR 3045);
Geothermal Steam Act of 1970 (30 U.S.C. 1001-1025) (43 CFR 3200);
Mining and Minerals Policy Act of 1970 (30 U.S.C. 21a).

lack of authority to control surface use was the institution of the withdrawal authority to close the public lands to mineral entry. The basis for these withdrawals is the inherent authority of the President and not the Pickett Act, 43 U.S.C. 141-142, because the Pickett Act does not provide for the withdrawal from the mining laws of metalliferous minerals, for example, gold.[8] In Alaska, pursuant to section 17 (d) (2) of the Alaska Native Claims Settlement Act, 43 U.S.C. 1616 (d) (2), Public Land Order 5179, 37 F.R. 5579, (March 16, 1972), withdrew 80 million acres from appropriation under the public land laws, including the mining laws. One exception to the general statement of lack of governmental authority to place surface restrictions on mining is the surface use regulations on mining operations in the National Forests promulgated in 1974. See 36 CFR 252. The legal authority for these regulations is the Forest Service Organic Act, 16 U.S.C. 551, 478, and not the mining laws. There are also regulations which govern surface use of mineral locations in Mount McKinley National Park, 36 CFR 7.44 and 43 CFR 3826.1, and Glacier Bay National Monument, 43 CFR 3826.4, and the legal authority for these regulations is in the acts establishing these areas. See 16 U.S.C. 350a (Mount McKinley) and 49 Stat. 1817 (Glacier Bay).

The Mineral Leasing Act of 1920, 30 U.S.C. 181-287, provides for the leasing of coal, oil, and gas (and several other minerals) owned by the United States. It is inapplicable in national parks and monuments and Naval petroleum reserves. Various provisions provided by 30 U.S.C. 187 in these leases, include "such other provisions as [the Secretary of the Interior] may deem necessary...for the protection of the interests of the United States...." Section 2(q) of the current oil and gas lease form (Form 3120-7, October, 1967) contains provisions for the protection of surface resources.[9] It includes a provision that states in part: "...and

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[8]See Study of Withdrawals and Reservations of Public Domain Lands, by Public Land Law Review Commission, 3 Vol., 1969.

[9]"(q) Protection of surface, natural resources and improvements. To take such reasonable steps as may be needed to prevent operations on the leased lands from unnecessarily: (1) causing or contributing to soil erosion or damaging crops, including forage, and timber growth thereon or on Federal or non-Federal lands in the vicinity; (2) polluting air and water; (3) damaging improvements owned by the United States or other parties; or (4) destroying, damaging or removing fossils, historic or prehistoric ruins, or artifacts; and upon any partial or total relinquishment or the cancellation or expiration of this lease, or at any other time prior thereto when required and to the extent deemed necessary by the lessor to fill any pits, ditches and other excavations, remove or cover all debris, and so far as reasonably possible, restore the surface of the leased land and access roads to their former condition, including the removal of structures as and if required. The lessor may prescribe the steps to be taken and restoration to be made with respect to the leased lands and improvements thereon whether or not owned by the United States."

so far as reasonably possible, restore the surface of the leased land and access roads to their former condition...." BLM is authorized in 43 CFR 3109.4-2 to require special stipulations necessary for the protection of lands embraced in cases of leases in certain withdrawals. On April 17, 1958, Secretary of the Interior Fred Seaton issued Circular No. 2000, which authorized the issuance of special stipulations for inclusion in permits and leases for surface control in "Alaska Wildlife Areas," which included the Kenai Moose Range. See 43 CFR 3109.4-2 and 43 CFR 3101.3-2 (d). The history of federal environmental stipulations for mineral development in Alaska--if not in the United States--began with those stipulations.

The geophysical exploration for oil and gas on the public lands is controlled by regulations contained in 43 CFR 3045. There are no provisions in the Mineral Leasing Act which regulate such geophysical exploration and the authority for the regulations is presumably 43 U.S.C. 1201, the general rulemaking authority of the Secretary of the Interior. The regulations require the filing of a "Notice of Intent to Conduct Oil and Gas Exploration Operations." This Notice of Intent contains a statement that the signers agree that exploration operations will be conducted pursuant to the terms and conditions listed on the form. One of the forms in use in Alaska, Form 3045-1 (December 1973), includes general provisions for surface protection. There is also the possibility for inserting special stipulations on that form. Special stipulations for winter and summer exploration operations have been developed for use in Alaska. Upon completion of exploration, a "Notice of Completion" must also be filed with the BLM.

The Materials Act of 1947, 30 U.S.C. 601 - 603, authorized the Secretary of the Interior to dispose of common varieties of mineral materials, which include sand, stone and gravel, and timber on the public lands. The Secretary of Agriculture has like authority in the National Forests. See 43 CFR 3600, 36 CFR 251.4. The Multiple Surface Use Act of 1955, 30 U.S.C. 601, precluded the further filing of mining claims based on common varieties of sand and stone and gravel and since then the Materials Act is the sole federal authority for the disposal of sand and gravel. The State, under the Submerged Lands Act, 43 U.S.C. 1301 et seq., is the owner of the sand and gravel in the beds of navigable bodies of water and those disposals are state disposals. Detailed regulations, enacted in 1969, control surface exploration, mining, and reclamation of lands involving sand and gravel disposals by the BLM.[10] See 43 CFR 23.

These are the principal mineral disposal statutes and regulations of importance in Alaska. The surface protection possibilities extend from the mining laws at one end of the spectrum to the leasing and sale statutes

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[10] See Olsen, Surface Reclamation Regulations on Federal and Indian Mineral Leases and Permits, supra.

at the other end of the spectrum. It is a safe generalization that there has been increasing surface use regulation since the time of the Mining Law of 1872.

4. Rights of Access

Access to mineral deposits is one of the principal questions discussed at mineral conferences attended by lawyers. I am sure that one of the reasons for such frequent discussion is that it is an unclear area of the law. I will explain some of these difficulties to you so that you can understand the surface protection problems associated with access.

The principal legal problem associated with access to mineral deposits is that the few statutes that deal with such access are inadequate. For example, the legal argument over the trans-Alaska pipeline was mainly an access problem while it was before the courts, although the resolution of the problem was decided on a broader basis by Congress. See Wilderness Society v. Morton, 479 F. 2d 842 (C.A.D.C. 1973) cert. denied, 411 U.S. 917. It was necessary for Congress to enact not only the "Trans-Alaska Pipeline Authorization Act," which is Title II of P.L. 93-153, 87 Stat. 576, 43 U.S.C. 1651-1655, but an amendment to section 28 of the Mineral Leasing Act of 1920, which is Title I of the Act, 30 U.S.C. 185. Title I dealt with the technical right-of-way problems involved in Wilderness Society v. Morton. Title II dealt with the National Environmental Policy Act questions which were never reached by the courts. The access problem I would like to discuss, however, is not pipeline rights-of-way but vehicular access.

The major environmental concern appears to be with access to mining claims. This is because the Mining Law of 1872 and its regulations do not provide for governmental approval of road construction on the public lands. This is not true of the Forest Service regulations, 36 CFR 251, which do require approval of road construction.

It is the legal position of the Department of the Interior that no authorization is needed for access across the public lands to mining claims: Alfred E. Koenig, 4 IBLA 18 (1971); Solicitor's Opinion, M-36584, 66 I.D. 361 (1959). The legal basis for this position is that the mining law "necessarily presupposes a right of passage as an incident to the other rights granted, and the general rule that free passage over the public lands has always been recognized." See Solicitor's Opinion, supra, at p. 362. Surface protection is difficult in this situation but the Solicitor's Opinion, at p. 366, recognizes that the miner may be "liable in damages if he unnecessarily causes loss or injury to the property of the United States" in the exercise of his right of access.

Private roads for mining purposes across the public roads are specifically authorized under the Act of January 21, 1895, 43 U.S.C. 956. These are technically referred to as tramroads. The difference between

tramroads and the miner's rights of access is that the tramroads require the approval of the Department of the Interior. The regulations 43 CFR 2811 provide that a tramroad right-of-way is valid for a six-month period, with the possibility of one six-month extension. A tramroad is subject to the terms and conditions of all rights-of-way which require departmental approval, 43 CFR 2801.1-5, which includes provisions for environmental protection.

Another significant road right-of-way statute is that referred to as "R.S. 2477" (the R.S. referring to Revised Statutes, the codification of federal statutes in effect prior to the U.S.C. designation). See 43 U.S.C. 932, 43 CFR 2822. This right-of-way provision was enacted as section 8 of the Act of July 26, 1866, which was the mining law of 1866. It provides as follows: "The right-of-way for the construction of highways over public lands, not reserved for public uses, is hereby granted." A number of legal questions are associated with the right-of-way grant under R.S. 2477. One of them arises from footnote language of United States v. Dunn, 478 F. 2d 443 (9th Cir. 1973), which stated that the statute was not intended to grant new rights-of-way but only to legalize rights-of-way existent prior to the 1866 Act. Also, one of the legal requirements for the acceptance of the grant is that it be by some governmental authority or by the public at large by user. See Hamerly v. Denton, 359 P. 2d 121 (Alaska 1961); Girves v. Kenai Peninsula Borough, Alaska Supreme Court, No. 1168 (June 13, 1975). Finally, if the lands are reserved, it is necessary for the applicant to file an application for a right-of-way. The regulations 43 CFR 2822.2-2(b) provide for the applicability of environmental protection measures in such cases. Public Land Order 5418, 39 F.R. 11547 (March 29, 1974) withdrew all remaining unreserved public lands in Alaska; therefore, any future right-of-way acquisition would be by way of application.

The final topic I would like to mention is on the subject of vehicular access across the public lands by off-road vehicles (ORV). The Department of the Interior published final regulations for ORV use of the public lands on April 15, 1974. These are 39 F.R. 13612 (1974). See 43 CFR 6290. The preamble to those final regulations stated that proposed exceptions to the ORV regulations for geophysical exploration for oil and gas and exploration and development under the mining laws had been deleted from the final regulations. Therefore, the ORV regulations do encompass those activities. The statutory basis for the ORV regulations is the general regulatory authority of the Department of the Interior over the public lands, 43 U.S.C. 1201, the National Environmental Policy Act of 1969, and Executive Order 11644, in 3 CFR, p. 332 (1974). The regulations establish criteria for designating restricted and closed areas and further provide that all public lands not so designated remain open to off-road vehicle use. National Wildlife Federation v. Morton, 396 F. Supp. 1286 (D.C. Dist. of Col. 1975) held that these

regulations were invalid.[11] One of the grounds of invalidation was that the designation of all public lands as open was not in conformity with E.O. 11644 in that it created "a subtle, but nevertheless real, inertial presumption in favor of ORV use" (at p. 1292). I understand that these regulations are under revision.

5. Sanctions for Noncompliance with Federal Surface Protection Requirements

In conclusion, I would like to discuss the authority of the Department of the Interior to enforce the federal requirements for surface protection. This is the basic question of whether or not the law has any teeth in it. The resolution of the question of whether or not there is effective enforcement authority for these requirements is, of course, with Congress.

A. Criminal Protection

I suppose that we might refer to this first option of Congress as the criminalization of environmental degradation. It is imperative in this sanction that there be a statute which sets out the offense and the penalty for a violation thereof. There are, however, only two federal statutes which make it a criminal offense to injure or destroy resources on the public domain, and these relate to the wanton destruction or willful setting of fire to timber on the public lands. See 18 U.S.C. 1852, 1855. There is a contrast between this approach and that of the more recent environmental pollution control statutes. For example, the Federal Water Pollution Control Act, 33 U.S.C. 1319 (c), criminalizes violations of the statutes or of conditions in permits issued thereunder. There are bills before Congress which would criminalize violations of regulations of the Department of the Interior and grant law enforcement authority to departmental employees. See S. 507, 94th Cong. 1st Sess., sec. 306-307.

B. Injunctions

The only way for the federal government to prevent an unwanted surface disturbance to the public lands is to obtain an injunction from the U. S. District Court which prohibits the objectionable activity. The most common procedure here is a request from the Department of the Interior to the Department of Justice to file a complaint which requests a permanent injunction accompanied by a motion for a preliminary objection pending a decision on the permanent injunction. It is necessary for the government to show at a hearing on the motion for preliminary injunction

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[11]But cf. Wilderness Society v. Morton, 479 F. 2d 842 (C.A.D.C. 1973), cert. denied 411 U.S. 917 (1973); Bird Bear v. McLean County, 513 F. 2d 190 (8th Cir. 1975). Also see, Biddle, Access Rights Over Public Lands Granted by the 1866 Mining Laws and Recent Regulations, in Rocky Mountain Mineral Law Institute, 1973, at pp. 415-435.

that there will be irreparable damage to the land. Most cases are actually resolved on the issue of the preliminary injunction. This is especially true when the government's case is not successful at this stage because the unwanted activity perhaps will have occurred by the time of a hearing on the permanent injunction. It may also be the case when the government obtains a preliminary injunction, however, because the defendant is then made aware of the probabilities of success by the government. See e.g., United States v. Barrows, 404 F. 2d 749 (9th Cir. 1968); United States v. Foresyth, 321 F. Supp. 761 (D. Colo. 1971). In the Barrows and Foresyth cases, the court granted preliminary injunctions which prohibited further mining operations of the defendants in National Forests pending an administrative decision on the validity of the claims.

C. Damages

A civil action for damages in the U. S. District Court is also an appropriate remedy when it is too late to prevent the damage by injunction. This is very often the case because of the almost impossible task of surveillance of the vast public domain in Alaska. The basis of a complaint for surface damage is trespass. There is no general trespass statute and the basis of such an action by the government is the property interest of the United States. The rule of damages in such cases is the measure of damages under state law, unless federal law prescribes a different rule.[12] Therefore, in a government trespass suit in Alaska, the U. S. District Court adopts as federal law the Alaska law on damages. G & A Contractors, Inc. v. Alaska Greenhouses, Inc., 517 P. 2d 1379 (Alaska 1974) held that the plaintiff may elect as damages in cases of surface disturbance the cost of restoration or the loss in value of the land. The appropriate measure of damages for surface disturbance, therefore, is the cost of restoration. These damages could be considerable in Alaska. I believe that it would be interesting for one of the conference participants to discuss these costs in detail because it would present a cost analysis of environmental degradation.

6. The "Taking" Issue

I would like to conclude my remarks with a brief reference to what lawyers refer to as the "taking" issue. I thought it might be interesting for all of us to realize that there is a point at which government regulation may become confiscation of private property. The issue arises out of the language of the Fifth Amendment to the U. S. Constitution, which provides: "(N)or shall private property be taken for public use, without just compensation."

Pennsylvania Coal Co. v. Mahon, 260 U.S. 393 (1922) is perhaps the leading case on the subject and it is pertinent to the discussion today

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[12]See 43 CFR 9239.0-8; Damages for Trespass on U. S. Lands, 58 I.D. 694 (1944); Moore's Federal Practice, Vol. 1A, Sec. 0.321.

because it did involve surface protection. The case involved the interpretation of a Pennsylvania statute that forbids the mining of coal in such a way as to cause the subsidence of, among other things, any structure used as a human habitation. An action was brought by the owner of a house to prevent the coal company from mining under his property. Justice Holmes held the statute unconstitutional and ruled in favor of the coal company. It is the language of the opinion that is significant, however, and I quote to you the significant part of it:

> "The general rule, at least, is that while property may be regulated to a certain extent, if regulation goes too far it will be recognized as a taking. It may be doubted how far exceptional cases, like the blowing up of a house to stop a conflagration, go--and if they go beyond the general rule, whether they do not stand as much upon tradition as upon principle....In general it is not plain that a man's misfortunes or necessities will justify his shifting the damages to his neighbor's shoulders. ...We are in danger of forgetting that a strong public desire to improve the public condition is not enough to warrant achieving the desire by a shorter cut than the constitutional way of paying for the change. As we already have said, this is a question of degree--and therefore cannot be disposed of by general propositions." (at pp. 415-416).

A recent decision relies upon Pennsylvania Coal Co. v. Mahon in the context of environmental protection, and I mention it to you so that you can appreciate the limits of regulation. Union Oil Company of California v. Morton, 512 F. 2d 743 (9th Cir. 1975) held that the Secretary of the Interior had the authority to suspend operations of Union Oil for a reasonable period of time under a lease in the Santa Barbara channel issued under the Outer Continental Shelf Lands Act so that the Secretary could further study the development of new technology to lessen threats to the environment. The court also held, however, that the Secretary did not have the authority to order an open-ended suspension of Union's operating rights under the lease. The court remanded the case to the District Court to determine the factual basis of the Secretary's suspension orders.

There is reason to believe that one of the most significant issues of environmental protection in the near future will involve the degree, of permissible regulation by the government to achieve environmental objectives. The general rules are so broadly stated at this time that it will be for the courts to determine under the peculiar circumstances of each case whether there has been a Fifth Amendment taking or a valid exercise of the police power. The courts will have to weigh the public interest in the protection of the environment against the public interest in the protection of property rights.

State Law of Surface Protection of the State Lands

Jeffrey B. Lowenfels

ABSTRACT
The primary source of authority to protect state lands is the Alaska State Constitution. The state legislature, given authority by the constitution, has delegated responsibilities for state land protection to the Department of Environmental Conservation, the Alaska Department of Natural Resources, and the Division of Lands. In this paper are listed those statutes and portions of the Alaska statutes describing the authority and other aspects of land protection. The definition of the term "land pollution" in Alaska statutes has been attacked as vague and may be subject to litigation. The effectiveness of laws to prevent land pollution has been subject to few tests as yet and only time will show their adequacy.

I have been asked to speak this morning on the state law and its application to surface protection of state lands. When I agreed to participate in this seminar, I thought of the old story of the newly elected corporate president who wanted to see how sharp his staff was. First, he asked his accountant how much two plus two was. The accountant took out his calculator and, as is common practice, added up the two figures and said, "Four." Pleased with his accounting staff, the corporate president then asked his engineer the same question. The engineer took out his slide rule, fiddled around with it, then turned to the corporate president and said, "About four." Pleased with the accuracy of his engineering staff, the president went to his attorney and asked him how much two plus two was. The attorney got up, pulled down his window shades, buzzed his

secretary and told her to hold his calls, pulled out a yellow legal pad and, turning to the corporate president, said, "Now, how much do you want it to be?"

In a sense, that is what the situation is in regard to Alaska law and the protection of surface lands. Accountants have definite answers. Engineers have approximate answers, but the attorney, making a speech in front of an august body such as this, finds there is a variety of approaches to the topic. Thus, my presentation will be only a general overview of what one member of the Alaska Department of Law considers to be the important sources of authority that can be used to protect Alaska lands from environmental degradation.

THE ALASKA CONSTITUTION

The primary source of authority to protect state lands is the Alaska State Constitution. Article 8 of the state constitution deals with Alaska's vast natural resources. Section one of the article is the statement of policy regarding our natural resources:

> "Section 1. Statement of Policy. It is the policy of the State to encourage the settlement of its land and the development of its resources by making them available for maximum use consistent with the public interest."

One of the areas which is considered to be within the public interest is conservation. (One must remember that that is the old word for protection of our environment, and it was still in vogue when our constitution was written in 1956!) This is evidenced by Section 2 of Article 8 which grants to the state legislature the power to enact laws to protect the surface environment of Alaskan lands.

> "Section 2. General Authority. The legislature shall provide for the utilization, development, and conservation of all natural resources belonging to the State, including land and waters, for the maximum benefit of its people."

Other sections of Article 8 provide further authority in support of this legislative power over lands. Section 6 states:

> "Section 6. State Public Domain. Lands and interests therein, including submerged and tidal lands, possessed or acquired by the State, and not used or intended exclusively for governmental purposes, constitute the state public domain. The legislature shall provide for the selection of lands granted to the State by the United States, and for the administration of the state public domain."

Finally, Section 8 describes leasing authority.

"Section 8. Leases. The legislature may provide for the leasing of, and the issuance of permits for exploration of, any part of the public domain or interest therein, subject to reasonable concurrent uses. Leases and permits shall provide, among other conditions, for payment by the party at fault for damage or injury arising from noncompliance with terms governing concurrent use, and for forfeiture in the event of breach of conditions."

This, then, is the primary source of authority to protect state lands. Since statehood, the State of Alaska has selected approximately 70 million acres of land, an area equal to about one-fifth of the entire state. By 1984, when the State must complete its land selection under the Statehood Act, nearly 30 percent of the land in Alaska will belong to the State. Except for the small fraction of this which will eventually find its way into private ownership, this land represents a public trust of unparalleled dimension. The framers of the state constitution must have realized this when they set up the basic foundation for the protection of our most abundant natural resource--land.

DEPARTMENT OF ENVIRONMENTAL CONSERVATION

The legislature, given the authority by the State Constitution, has delegated part of its responsibility to protect state lands to the Department of Environmental Conservation. This occurred as a result of sweeping legislation passed in 1971 which resulted in the creation of the Department and Title 46 of the Alaska statutes. Title 46 was, I think, inappropriately titled "Water, air, and environmental conservation." Fortunately, the absence of the term "land" is corrected in the declaration of policy which is set out in Section 46.03.010:

"Sec. 46.03.010. Declaration of policy. (a) It is the policy of the state to conserve, improve and protect its natural resources and environment and control water, land and air pollution, in order to enhance the health, safety and welfare of the people of the state and their overall economic and social well-being."

The powers of the Department of Environmental Conservation are set out in AS 46.03.020. Besides having the authority to review and appraise programs and activities of other state departments and agencies in light of the policy set out in the introduction to Title 46, the department may adopt regulations providing for the control, prevention, and abatement of air, water, and land pollution. In addition, the department has been given the power to adopt any regulation consistent with the policy declaration.

While AS 46.03 has major sections dealing with air, radiation, water, and pesticide pollution, it does not have a section dealing specifically with land pollution. One section of Title 46, Article 7, however, does provide some additional authority to control land pollution. This is the

"prohibited acts" section. Under it, "No person may pollute or add to the pollution of the air, land, subsurface land or water of the state."

The penalties for polluting land are also set out in this section:

"A person who violates §§ 710, 730, 740, or 750 of this chapter is guilty of a misdemeanor and upon conviction is punishable by a fine of not more than $25,000, or by imprisonment for not more than one year, or by both. Each unlawful act constitutes a separate offense."

And AS 46.03.780 provides for liability for restoration of lands affected:

"(a) A person who violates a provision of this chapter, or who fails to perform a duty imposed by this chapter, or violates or disregards an order, permit, or other determination of the department made under the provisions of this chapter, and thereby causes the death of fish, animals, or vegetation or otherwise injures or degrades the environment of the state is liable to the state for damages.

"(b) Liability for damages under (a) of this section includes an amount equal to the sum of money required to restock injured land or waters, to replenish a damaged or degraded resource, or to otherwise restore the environment of the state to its condition before the injury.

"(c) Damages under (a) of this section shall be recovered by the attorney general on behalf of the state.
(§3ch120SLA1971)

"Sec. 46.03.790. Wilful violation. (a) A person found guilty of wilfully violating a provision of this chapter, or a regulation, written order or directive of the department or of a court made under this chapter is guilty of a misdemeanor, and upon conviction shall be punished by a fine of not more than $1,000 and costs of prosecution, or by imprisonment for not more than one year, or by both such fine, cost, and imprisonment at the discretion of the court.

"(b) Each day upon which a wilful violation of the provisions of this chapter occurs may be considered a separate and additional violation."

Next, the Department of Environmental Conservation has certain emergency powers.

"Sec. 46.03.820. Emergency powers. (a) When the department finds, after investigation, that a person is causing, engaging in or

maintaining a condition or activity which, in the judgment of its commissioner presents an imminent or present danger to the health or welfare of the people of the state or would result in or be likely to result in irreversible or irreparable damage to the natural resources or environment, and it appears to be prejudicial to the interests of the people of the state to delay action until an opportunity for a hearing can be provided, the department may, without prior hearing, order that person by notice to discontinue, abate or alleviate the condition or activity. The proscribed condition or activity shall be immediately discontinued, abated or alleviated."

Now, one thing has been left out of the discussion so far. What is the definition of land pollution? In its infinite wisdom, the legislature gave this definition to be used in connection with Title 46:

"(15) 'pollution' means the contamination or altering of waters, land or subsurface land of the state in a manner which creates a nuisance or makes waters, land or subsurface land unclean, or noxious, or impure, or unfit so that they are actually or potentially harmful or detrimental or injurious to public health, safety or welfare, to domestic, commercial, industrial, or recreational use, or to livestock, wild animals, bird, fish, or other aquatic life;"

A friend of mine sat down and figured out how many permutations of this definition there are. The figure is an astounding, more than 4,000 combinations! The definition had been attacked as void for vagueness in one case here in Alaska (the Stock case), but upheld under the circumstances of the case. I am certain that the definition of "pollution" will be the subject of further litigation.

I know of only two cases that deal with land pollution. The first was settled out of court with an admission of guilt by the offending party. The second suit is pending, and I am not at liberty to discuss it.

<u>THE ALASKA DEPARTMENT OF NATURAL RESOURCES AND THE DIVISION OF LANDS</u>

The second primary authority delegated by the legislature deals with the protection of state lands and reposes in the Alaska Department of Natural Resources and the Division of Lands. This is set out in AS 38.05, and is known as the Alaska Land Act. This act defines the duties of the Division of Lands in regard to the public lands of the state.

The Commissioner of Natural Resources has the following power:

"Sec. 38.05.020. <u>Authority and duties of the commissioner</u>. (a) The commissioner shall supervise the administration of the land division.

"(b) The commissioner may

"(1) establish reasonable procedures and adopt reasonable rules and regulations necessary to carry out this chapter and may, whenever necessary, issue directives or orders to the director to carry out specific functions and duties; all rules and regulations adopted by the commissioner shall be adopted under the Administrative Procedure Act (AS 44.62); orders by the commissioner classifying lands issued after January 3, 1959, are not required to be adopted under the Administrative Procedure Act (AS 44.62);"

The Director of the Division of Lands is given the power to execute these regulations and orders:

"Sec. 38.05.035. Powers and duties of the director. (a) The director shall

"(1) have general charge and supervision of the division and may exercise the powers specifically delegated to him; may employ and fix the compensation of assistants and employees necessary for the operations of the division; and is the certifying officer of the division, with the consent of the commissioner, and may approve vouchers for disbursements of money appropriated to the division;

"(2) manage, inspect and control state lands and improvements on them belonging to the state and under the jurisdiction of the division;

"(3) execute laws, rules, regulations and orders adopted by the commissioner;"

Thus, the leasing of state lands, for example, is governed by regulations promulgated by the Commissioner of the Department of Natural Resources and executed by the Director of the Alaska Division of Lands. It has been the practice of the Division of Lands to consult with other state and local agencies when granting leases of all kinds. Thus, with input from the Department of Environmental Conservation, the Department of Fish and Game and other agencies, many leases contain provisions which seek to protect the surface of the lands involved.

Finally, there is the most important section of Title 38, 38.05.360 which states:

"Sec. 38.05.360. Waste or injury to land. A person who commits waste, or trespass or other injury upon state land, in addition to being civilly liable for damages caused, upon conviction, is punishable by a fine of not more than $1,000."

This provision is the basis for the suit mentioned earlier that is currently pending.

Later this week, Dr. Michael C. T. Smith, director of the Division of Lands, will speak to you concerning the policies which are implemented by the sections I have summarized. Some of these policies are evident from the regulations which have been promulgated by the Alaska Division of Lands. In particular, I wish to point out those regulations contained in Chapter 96 of the 11 AAC.

"11AAC 96.010. OPERATIONS REQUIRING PERMITS. A permit is required for the following activities on state lands:

"..

(2) activity which the director determines may result in unnecessary harm to lands having special scenic, historic, archaeological, scientific, biological, recreational, or other special resource values. The activities will be listed, and the lands designated as 'Special Use Lands,' on the official records of the division. The records will be available in all state land offices. Activities requiring a permit on lands so designated will not be considered a violation of these regulations unless the user has received written notice of the designation or the designation has been effective for 90 days;"

"11 AAC 96.070. COMPLETION OF OPERATIONS. Upon completion of the operations under a permit and its extensions, the permittee shall file a map showing the location of all permit activities which were not shown in the permit plan, or any modifications of the permit plan, and include a detailed statement of cleanup and restoration work at the site. Within 90 days of filing an acceptable completion statement, the permittee will be notified of any cleanup and restoration work required. (Eff. 1/1/70, Reg. 32)

Authority: AS 38.05.020
AS 38.05.035"

"11 AAC 96.100. PENALTY. Any activities on state lands done in violation of secs. 10-150 of this chapter shall be considered waste, trespass, or injury to state lands under AS 38.05.360. (Eff. 1/1/70, Reg. 32)

Authority: AS 38.05.020
AS 38.05.035"

"11 AAC 96.120. PURPOSE. The purpose of secs. 10-150 of this chapter is to provide controls over activities on State of Alaska lands in order to minimize adverse effects on the land and its resources. (Eff. 1/1/70, Reg. 32)

Authority: AS 38.05.020
AS 38.05.035
AS 41.20.020"

"11 AAC 96.130. APPLICABILITY. Secs. 10-150 of this chapter apply to all land use activities on Alaska state lands except activities authorized under any State Division of Lands administered permit, lease, or contract, by the permit, lease, or contract holder, or his authorized agent and except lands which have, by administrative action or act of the legislature, been reserved from multiple use management. (Eff. 1/1/70, Reg. 32)

Authority: AS 38.05.020
AS 38.05.035"

And of particular interest to this group:

"11 AAC 96.140. GENERAL STIPULATIONS. All land use activities are subject to the following provisions:

"(1) Activities employing wheeled or tracked vehicles shall be conducted in such a manner as to minimize surface damage.

"(2) Existing roads and trails shall be used whenever possible. Trail widths shall be kept to the minimum necessary. Trail surface may be cleared of timber, stumps, and snags. Due care shall be used to avoid excessive scarring or removal of ground vegetative cover."

That is the extent of our laws to prevent "land pollution." Alaska has an abundance of land to protect from pollution and spoilation. Fortunately, Alaska's lands are largely unpolluted because of our low population and limited industry. Since pollution of the surface of our lands is not widespread, we have the unique opportunity to prevent rather than correct damage.

The tests of the strength of our land laws designed to prevent pollution are few. Will they prove to be adequate and meet the obvious impending onslaught of cases?

Time will tell.

The Trans-Alaska Pipeline System Act

William J. Moses

ABSTRACT
The Trans-Alaska Pipeline System (TAPS) Act consists of four titles. Title 1 is the amendment to Section 28 of the Mineral Leasing Act of 1920. Title 2 is the TAPS authorization act. Title 3 deals with negotiations with Canada. Title 4 sets forth miscellaneous provisions such as Section 403, the civil rights section. Title 2 and Title 1 are discussed in that order as most appropriate to the seminar topic. After January 1973, the federal government issued federal authorizations under the TAPS Act. These may be grouped into categories such as that of authorizations to the State of Alaska, a category including 30-year grants of right-of-way for the line pipe and related facilities and for access roads, another category relating to mineral materials, and a final category consisting of various types of temporary permits.

When I was asked to speak on the Trans-Alaska Pipeline System (TAPS) project and laws applicable to it, I reviewed the Act, which I live with day-to-day, and came up with what I felt was a concise summary of what it is all about. Yesterday evening, somewhere between the Walt Disney program and the feature "Eleanor and FDR," my wife and youngest son looked at some of my notes. My son commented, "Oh, Daddy, you're not going to talk about something as boring as that, are you?"

With their reaction in mind, I decided to cover just the highlights, recognizing that in this room are some of the real experts on various

aspects of TAPS. I would like to avoid covering the technical aspects of the so-called TAPS stipulations and do perhaps the one thing that, as a lawyer, I should be doing: discuss basically the law itself.

Public Law 93-153, the TAPS Act, was passed by the U. S. Congress in November 1973. It consists of four titles. The first title is the amendment to Section 28 of the Mineral Leasing Act of 1920. Title 2 is the Trans-Alaska Pipeline Authorization Act. Title 3 deals with negotiations with Canada, and Title 4 sets forth miscellaneous provisions. Actually, we are interested in Title 2 and Title 1, in that order. Title 3 has received some public attention recently because of the Title 3 study on feasibility of an oil-gas line across Canada. Title 4 should be mentioned briefly, as it contains Section 403, the civil rights and equal opportunity section, which provides for nondiscrimination in activities conducted under Title 2 permits, rights-of-way, and authorizations.

Title 2

Let's look at Title 2, which consists of six sections. The first section is nothing more than the short title, stating that this is to be known as the Trans-Alaska Pipeline Authorization Act. Section 202, the second section, sets forth the congressional findings that construction and delivery of North Slope oil and gas are in the nation's interest and that the Department of the Interior and other federal agencies had conducted extensive studies, etc.

Section 203 is really the significant section in the TAPS Act. This section contains the congressional authorization or mandate, and I would like to dwell on this somewhat because it has some unique aspects. In Subsection (a), Congress states the purpose of the act and it's rather interesting to note the exact language used. Congress states that ". . . it is the intent of Congress to exercise its constitutional powers to the fullest extent. . ." in enacting the law. This language should be kept in mind because I'll touch upon it later.

Subsection 203 (b) is the congressional authorization and direction to the Secretary of the Interior and to any other appropriate federal officers or agencies to take all necessary action to issue, administer, and enforce rights-of-way, authorizations, and permits necessary for or related to construction, operation, and maintenance of the TAPS project.

Subsection (c) is quite complicated but it says essentially that authorizations issued under the TAPS Act are subject to the provision of Title 1; that is to say, the amendments to Section 28 of the Mineral Leasing Act, with certain specified exceptions. Authorizations under Section 203 (b) of the TAPS Act are subject to mandatory provisions of law that would otherwise be applicable were it not for the enactment of the TAPS law itself.

Congress also provided that so-called discretionary or procedural provisions that would otherwise be applicable but not mandatory may be inserted into the appropriate federal authorization. They may also be waived.

Congress then concluded this subsection by once again using some rather blunt language. It said that the directions contained in Subsection 203 (b) are to the Secretary of the Interior and to all federal officers and agencies to take all necessary actions to issue authorizations to build the pipeline. Those directions shall supersede the provisions of any laws or regulations relating to an administrative determination as to whether the authorizations for construction of the trans-Alaska oil pipeline shall be issued.

Since Subsections (b) and (c) mandated that the authorizations necessary to construct the pipeline and get it to full capacity be issued, the job of federal officials is to make sure that the appropriate stipulations, conditions, terms, and the like are inserted in the authorizations.

Subsection (d) of 203 is perhaps the one subsection that most people are familiar with. This is the so-called NEPA override provision. Subsection (d) also contains some unique language. Congress specifically provides that actions of federal officers concerning issuance of necessary permits for construction of the line shall not be subject to judicial review in any court with the following exceptions: Claims alleging the invalidity of the statute itself can be brought within 60 days of enactment of the statute; claims involving an alleged denial of constitutional rights and claims alleging that the actions of a particular federal official exceed the authority of the act can be brought within 60 days of the action complained of.

Congress went further by providing that any such claim that is permissible under Subsection 203 (d) under any state or federal law can be brought only in the U. S. District Court. The complaining party is not entitled to preliminary injunctive relief in that proceeding. The hearing itself is entitled to an early setting and review of the District Court decision is directly to the Supreme Court of the United States.

Subsection (e) of 203 says that the Secretary of the Interior or other federal officials can amend or modify at any time any authorization issued under the TAPS Act when necessary to protect the public interest. I submit to you that Section 203 makes quite clear that this congressional enactment is unique.

Let's look now at Section 204. This is the so-called liability section and consists of three separate concepts, each of which is a concept of strict liability or liability without fault. The limits of liability differ in each subsection, however.

Subsection 204 (a) deals basically with Alaska Natives, their organizations, and other persons who rely on fish, wildlife, and other resources for subsistence purposes and who live on or near the pipeline right-of-way. In this subsection, congressional directions are not limited merely to federal lands. Essentially, the subsection provides strict liability for the holder of the right-of-way, the original permittee companies.

Subsection 204 (b) has a slightly different wording. Again, it imposes strict liability that relates to pollution, on or off federal lands, which results in damages to the public or private persons. It essentially provides a rule of strict liability for those damages and further provides that if the holders of the right-of-way permits don't adequately correct the damage, the Secretary of the Interior has the authority, with other federal and state agencies, to repair the damage and bill the holders of the right-of-way.

Subsection (c) of Section 204 is the third and final area of liability. This involves discharges of oil from tankers carrying oil that has been transported through the TAPS pipeline. It imposes absolute liability and is not limited to federal lands. As a matter of fact, the scope is broad enough to cover damage incurred by Canadian citizens.

A bill that is pending, H. R. 9294, should be noted here. It is called the Comprehensive Oil Pollution Liability and Compensation Act. If passed by Congress in 1976 in its present form, it would supersede Subsection 204 (c) and provide a comprehensive federal standard not limited to TAPS oil spills.

The fifth section of the TAPS Act says simply that the grant of right-of-way issued under the act doesn't provide the various holders of rights-of-way with immunity from the antitrust laws.

The sixth and final section of the TAPS Act provides that a right-of-way or permit under Subsection 203 (b) for a road or airport can be for a public road or airport.

This then is the TAPS Act itself. Because the TAPS Act in Section 203 mandates incorporating the provisions of Section 28 of the Mineral Leasing Act into authorizations issued under the TAPS Act, it is necessary to look at Title 1.

Title 1

Title 1 is a lengthy, detailed statute. I will highlight just a few of the significant subsections in Title 1 that concern the TAPS project.

The definition section found in Section 28 (b) defines federal

lands in this manner: ". . .all lands owned by the United States except lands in National Park systems, lands held in trust for Indians or Indian tribes, and the Outer Continental Shelf."

As of November 1973, Section 28 presumably was going to be the basic statutory authority for using pipeline rights-of-way across federal lands with noted exceptions. A little more than a year after Section 28 was enacted, however, a technical amendment was made to the National Wildlife Refuge System Act, 16 USC 668dd, which raises a question as to whether National Wildlife Refuge lands are still covered by Section 28. The Department is presently considering the relationship of the two statutes.

Subsection 28 (d) is where we get to the width of the right-of-way, which is basically 50 feet plus the land occupied by the line and its related facilities. The term "related facilities" is defined to mean such things as communication sites, block valves, etc. A provision now enables the Secretary of the Interior to make determinations that a greater width is needed if he records the reasons for that determination.

Subsection 28 (e) gave the specific authority for temporary permits, which we use extensively on the TAPS project.

Perhaps the really significant subsection of Section 28, as far as we on the TAPS project are concerned, and perhaps as far as you as land managers should be concerned, is Subsection 28 (h) (2). This is the environmental protection language. It is the legislative basis for the stipulations used on the TAPS project. Basically, the Secretary is required under Subsection 28 (h) (2) to provide either regulations or stipulations covering environmental protection. Regulations have not been issued to date by BLM although draft regulations were published by U. S. Fish and Wildlife Service this spring. Since they weren't issued at the time the TAPS project was ready to go, we used stipulations that have been worked on for so many years by some of you in this room.

Presumably, when the Department of the Interior issues regulations under Subsection 28 (h) (2), many of the things that have been covered in the stipulations that are universal in scope will be put into regulatory form and the stipulations will be changed to the special conditions necessary for a particular project.

What has to be covered in the stipulations or regulations? First is a restoration plan for vegetation, methods to curtail erosion, methods to ensure that air, water quality, and facility siting standards are met, and requirements to control or prevent damage to the environment, including fish and wildlife habitat. Damage to public or private property and hazards to public health must be covered in the stipulations. The interests of people who live in the general area and who rely on fish, wildlife, and other biotic resources for subsistence must be considered.

Most of the other subsections of Section 28 are not significant here except for Subsection 28 (v). This section, entitled "State Standards," provides that "The Secretary or agency head shall take into consideration, and to the extent practicable, comply with the state standards for right-of-way construction, operation, and maintenance."

Once again I quote from Title 1 because Congress succinctly stated what it meant and I think those of you who are federal land managers ought to be familiar with the following: "Section 28 (v) relating to state standards is included because rights-of-way frequently cross from state or private land into federal land and back to state or private land. Different construction, operation, and maintenance standards may apply. This section is intended to ensure that the Secretary or agency head will carefully consider state standards and comply with them in the interest of uniform practice throughout the state where such compliance is practical in the judgment of the Secretary or agency head. The section is not intended to require that those standards are to be followed in every case."

This is essentially the same approach that the executive branch of the federal government used in Executive Order 11752, published December 19, 1973, in the Federal Register, regarding prevention, control, and abatement of environmental pollution of federal facilities. In that executive order the President provided that to further the purposes and policies of basic environmental acts, such as those covering clean air, water quality, insecticides, and fungicides, federal facilities are required to comply with federal, state, interstate, and local substantive standards and limitations to the same extent that any other person is subject to them. But in the light of the principle of federal supremacy found in the U. S. Constitution, federal facilities need not comply with state or local administrative procedures with respect to pollution abatement and control.

I refer to this executive order because the term "federal facilities" is defined broadly enough to include lands owned by the federal government. This executive order is still in effect.

Before leaving the TAPS Act and Section 28 of the Mineral Leasing Act, I would like to make one comment regarding a point Mr. Price raised earlier on the constitutional basis for laws relating to the public lands. As he pointed out, the property clause in the Constitution is the traditional basis for this type of legislation. From this discussion of some of the details of the TAPS Act and Section 28 of the Mineral Leasing Act, however, it is probably apparent that the statutes refer to activities that may or may not be related directly to federal lands. Thus, the question arises of whether or not there is a broader constitutional basis than just the "property clause."

In a case before the United States Supreme Court, Brown vs. Morton, which tests the constitutionality of the TAPS Act, the United States has

taken the position that the act was a broad constitutional exercise of congressional authority and that the basis was more than merely the property clause of the Constitution. The United States' position was sustained by the Supreme Court in a brief decision upholding the lower court finding of constitutionality.

Federal Authorizations under the TAPS Act

Let me now try to bring this to a rapid close by describing briefly the authorizations that are actually used on the TAPS project. These are basically the agreement and grant of right-of-way between the United States and the original seven permittee companies for the TAPS project. It is comprised of 44 sections, most of which contain administrative types of provisions dealing with the relation of the United States and the permittee companies, but including some substantive provisions. For example, the provisions relating to the Port of Valdez terminal site are in the basic agreement.

The next part of the basic document is Exhibit A, which describes the scope of the grant in the basic document. Not only is the alignment of the pipeline described, but various other related facilities, communication sites, the Valdez terminal site, and valve sites are listed.

Exhibit B should be of interest to those of you with the federal government, because even though the Department of the Interior eventually issues regulations pursuant to Subsection 28 (h) (2) of the Mineral Leasing Act regarding environmental protection, there will be times when special conditions are needed to meet special circumstances. Exhibit B relates to requirements for the Department of Defense on military installations. These special needs and circumstances are going to exist even if environmental protection takes a regulatory form.

Exhibit C is an extremely short exhibit, dealing with requirements of the Federal Power Commission relating to power sites. Once again, this sort of thing is undoubtedly going to be part of the right-of-way authorizations in the future, regardless of what the Department of the Interior does in the way of regulations under Section 28.

Exhibit D includes the basic stipulations, divided into three categories: general, environmental, and technical. That's really getting out of the scope of expertise of a lawyer and into the fields of land managers, environmentalists, and engineers. I will leave that for the experts to discuss.

After January 24, 1973, the federal government issued a broad variety of other federal authorizations under the TAPS Act. I'm not sure what the exact figures are, but perhaps there are up to a thousand. These fall into several general categories. There is a broad category of authorizations to the State of Alaska. Those include authorizations for the road, three airports, and communication sites. Another category

includes various temporary use permits, and authorizations for construction zones, spoil disposal sites, and temporary erosion-control sites. There is also a category including 30-year grants of right-of-way for access roads. The other big category relates to mineral materials.

State Stipulations

The State, by virtue of its cooperative agreement with the Department of the Interior, has issued its own set of stipulations that are essentially identical to the federal stipulations, subject to a few notable exceptions. The only substantial exception to the standard-form stipulations are those that were negotiated and agreed upon by the State of Alaska and the Department of the Interior relating to highways and airports. We came up with slightly different stipulations, which were attached to our authorizing documents. Otherwise, the only differences between stipulations attached to Exhibit D, the main right-of-way and those attached to the various temporary use authorizations are some minor word changes to indicate that they refer to supplemental authorizations rather than to the principal grant of right-of-way.

Ecological and Environmental Consequences of Off-Road Traffic in Northern Regions

Jerry Brown

ABSTRACT
The consequences of off-road activities depend on when the activity occurs (summer vs. winter), the degree of impact, the nature and response of the underlying permafrost to the surface modification, and the rate at which the damaged environment will recover. Regulations based on a knowledge of the environmental variables and how they react to impact are required to minimize impact in these areas which are sensitive to human and natural perturbations. We should not underestimate the requirement for good environmental information and adequate resource mapping as first, necessary steps.

I have found the discussion just concluded extremely interesting. Many of us have been asking for some time what types of constraints should be placed on environmental disturbance due to development and which areas should be conserved. I would hope that in the course of the week's meeting we might, in addition to the main subject of the seminar, talk a bit more about conservation practices. Conservation and surface protection are closely related, and we should seek common solutions for both where practical.

This report was prepared under USA CRREL Corps of Engineers sponsored project, "Research in snow, ice, and frozen ground; cold regions environmental factors."

I appreciate sharing the platform with the lawyers. Scientists are commonly accused of not having all the answers and it sounds to me as though we've found our equals!

I was planning to conclude my presentation with several remarks that I'm now going to put up front because we may run over into the lunch hour, and in the process lose a few of you. I had planned to conclude by saying that we've recently gone through a period of technological conquest of Nature in the Arctic. The question is whether we will continue simply to conquer or overpower Nature or will design our activities with Nature, a concept emphasized in the Environment Protection Report of Canada. One aspect of design is regulation. Some of my comments this morning will emphasize the need to better understand the environment in order to design and implement rational regulations.

The question of restoration has been raised by a previous speaker, and it is extremely interesting and pertinent. Traditionally, revegetation is an agricultural problem, and many of us trained in agriculture are aware of some of the agronomic solutions to revegetation. We are also concerned with applying ecological concepts to long-term restoration needs. I would hope that we will define these terms more precisely. "Restoration" implies the returning of the environment to approximately the original conditions. Revegetation and rehabilitation are more or less an interim process to provide a vegetated cover to prevent erosion.

Surface protection is a subject that's very close to our research interests. In recent years we've been looking at surface modification, which is the corollary of surface protection. A great deal of manmade environmental modification currently is taking place. Our concern is how to minimize the various impacts of surface modifications.

It is commendable that BLM is continuing to fulfill its responsibility and leadership for surface protection. An earlier report (BLM 1973) provides insight into the surface disturbance problems in permafrost areas of Alaska. I think we're going to make progress this week and undoubtedly there will be needs for additional follow-up. I'm pleased to see that there is a good representation of public and private groups present since some of us don't often have the opportunity to interact with other than the government and university people.

I'm going to confine my remarks almost entirely to tundra and primarily to Alaskan tundra. Many of the federal and state agencies here in Alaska have considerable experience in nontundra areas. On the other hand, until recently university-based research activities have concentrated in the tundra.

Tundra also has received a considerable amount of international attention over the last several years in both North American and other circumpolar countries. The U. S. currently is involved at the federal level in discussions with the Soviet Union on protection of the northern

environment. I will leave in the back of the room several reports which deal with some of the recent Soviet environmental literature. One is a short translation on protection of natural environments in the tundra (Khantimer 1975). It's a statement on the environmental problems around one of the major northern cities in Siberia. The report indicates that the Soviets are vocal on the issue of conservation and protection of their northern environment, particularly as development and recreation exert greater pressure on the land. Another translation contains a series of abstracts from an All-Union Conference held in October 1975 in Moscow. The conference topic was "Environmental Protection in Relation to Economic Development of Permafrost Regions." The abstracts deal with the initial organization of scientific and engineering disciplines in the Soviet Union for purposes of constructing pipelines, railroads, and highways within reasonable environmental constraints (Melnikov 1976).

My main objectives this morning are to discuss some of the principles of tundra impact and their consequences. I'll rely heavily on some results of past observations and on slides to illustrate these.[1]

By necessity the traditional form of overland transport in the arctic tundra has always been cross country or off-road. The Yukon River-Prudhoe Bay haul road and the local road net at Prudhoe make it possible to use conventional wheeled vehicles on roads in these tundra areas. Limited use of wheeled vehicles has been common throughout the Arctic in local camps and villages. A variety of tracked vehicles have been employed over the past three decades; Weasel, Nodwell, Bombardier, LVT, snow machines, and bulldozers. Recently, surface effect vehicles (SEV) or air-cushion vehicles (ACV) have been experimented with and low-pressure, balloon-tired vehicles (Rolligon) are now in common use in both summer and winter.

Visual impact is a very conspicuous type of modification, particularly as viewed from the air. It's one that has considerable public interest and one that has yet to be quantified from an ecological standpoint. Another major impact is terrain degradation. Impact to wildlife can occur from vehicle harassment and removal of habitat or damage to it. Finally, terrestrial inputs have an impact on water quality or the aquatic ecosystem.

Terrain degradation can occur by thermal erosion or thermokarst. Thermal erosion requires flowing water and the presence of ground ice. Thermokarst differs considerably from thermal erosion in that it does not require moving water. Heat is simply conducted into the substrata of the ice-rich permafrost and melting of the ice occurs in place. Thermokarst can occur on both slopes and flat terrain. In the Canadian Arctic, for instance, the ground under bulldozed trails has subsided and

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[1]Because of printing limitations, color slides used by Dr. Brown in his seminar presentation are not reproduced here.

gullied without the influence of running water; there was simply a settling of the ground as ice was removed (Mackay 1970). The off site consequences of thermokarsting are different from thermal erosion in that with thermokarst, sediments and soil nutrients do not run off into the streams. Therefore, thermokarst does not directly or adversely affect fish resources or water quality. With thermal erosion there is always the potential of reducing water quality and the aquatic biota.

I'd like to talk briefly about why tundra is frequently referred to as being "fragile" (Bliss 1970). Others of us talk about the tundra as being sensitive. Tundra has a very low species number compared with other ecosystems. Loss of any plant or animal species or a serious reduction in species may be more serious than in other diversified ecosystems.

Another major aspect of tundra is its low production. Plant growth is limited to a very short period of time and this shortness of growing season and accompanying low temperatures and droughtiness are serious limitations to recovery of damaged surfaces.

Probably the most important aspect of tundra sensitivity is the potential for the depth of thaw to increase followed by degradation of the permafrost. Figure 1 shows the seasonality of the arctic tundra and some of its major characteristics: the low mean annual temperature, the seasonal developments of the snow cover and active layer, and the

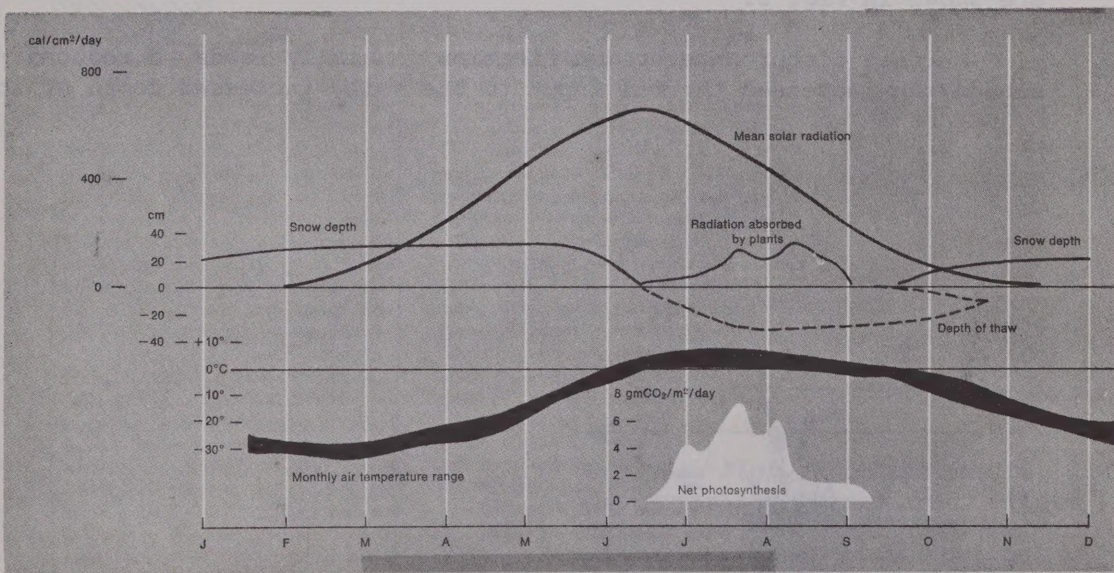

Fig. 1. Seasonal course of several abiotic and biotic activities for the arctic tundra (from Mosaic, *Vol. 1, No. 1. 1974).*

short period available for vegetation to grow. Because 50 percent of the annual radiation is received before the snow cover disappears, the annual growth of arctic vegetation occurs as the incoming solar radiation is decreasing. As a result of the negative mean annual temperatures, permafrost develops and persists in Alaska. In the northern areas where it's colder, there is the continuous zone of permafrost with the discontinuous zone occurring in the warmer areas of the south. In summary, we might think of tundra sensitivity in terms of limited plant growth and the potential for accelerated thaw and erosion.

Over the years we've been asking the questions, "How do we measure impact and to what condition do we restore the affected environment?" Some have developed classifications for these impacts. One Canadian study proposed a numerical scale from one to nine (Radforth 1972). Number four represented 10 percent removal of vegetation. Our own efforts led to the following general and relative scale (Rickard and Brown 1974): 1) esthetically objectionable, 2) minimal disturbance to vegetation, 3) significant destruction of the plant cover, and 4) disruption of surface peat. A scale to measure impact is important in order to know how to prevent or minimize the impact. We often recommend a remedial measure for the entire range of impact and do not find an answer for a given condition of impact. The problem remains as to what is an acceptable level of impact and what is an acceptable level of restoration once impact occurs.

The major components of the tundra, the plant canopy, ground interface, the thawed organic and mineral soil, and the underlying permafrost are shown in Fig. 2.

Surface disturbance or modification generally leads to reduced albedo, an increased thermal input to the soil, increased depth of active

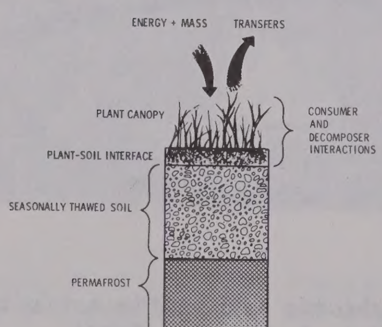

Fig. 2. Major components of the tundra systems.

layer, and the thawing of the underlying permafrost. If there is very little ground ice, plant growth can stabilize the surface, and major subsidence is not a concern. When large quantities of ice are in the permafrost, potential is good for subsidence and/or thermal erosion. The natural plant cover has difficulty becoming re-established because the subsurface has been changed drastically. Mechanical methods of stabilization may be required before a stable plant cover can become established.

The major form of surface disturbance in the past has been by off-road vehicular traffic. Hok (1969) presented excellent documentation of the consequences of off-road activity during the early exploration of NPR4. It's not necessary in this written report to illustrate the many examples still present. Suffice to say, the arctic terrain is well imprinted with evidence of past activity. Current forms of disturbances are more subtle and more time may be required before we can judge their significance. I refer to potential impacts of dust blowing off roads, early induced snow melt, the increased likelihood of air pollution affecting tundra vegetation, and crushing effects on vegetation of low-pressure vehicles across both snow-covered and snow-free terrain.

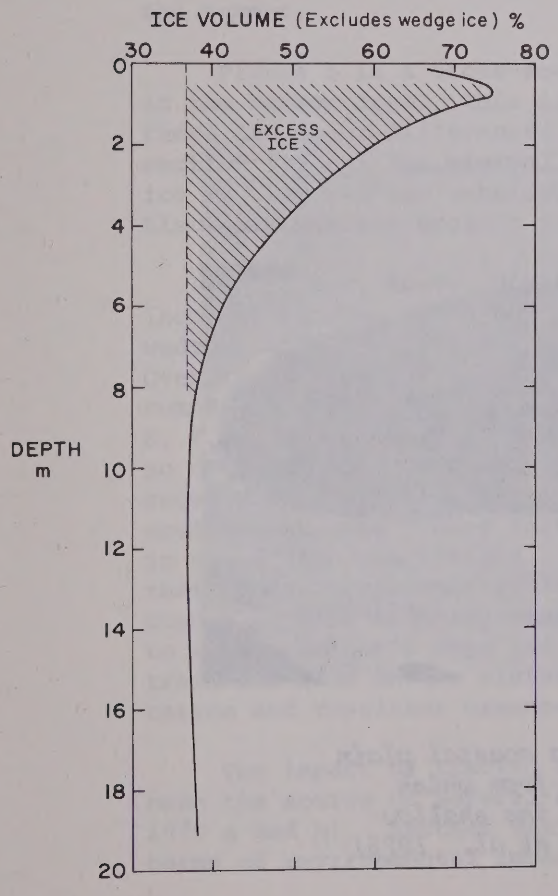

Fig. 3. Plot of ice volume vs. depth for the Barrow area. These values are for segregated ice and do not include the volume of ice associated with ice wedges, which may be as high as 10 to 20 percent. (Sellmann et al. 1975)

Ice occurs in the permafrost in two major forms, segregated ice and ice wedge ice. The segregated ice forms as the original sediment slowly freezes and water is drawn into the freezing ground. In Fig. 3 is shown the depth-distribution of this segregated ice contained in the upper layer of permafrost. This distribution is characteristic of most of the permafrost west of the Colville Delta, whereas the permafrost in the Prudhoe Bay area has a lower ice content, mainly due to coarser grain substrata. This high ice volume in the upper several meters of the permafrost is the reason that subsidence and erosion follow surface disturbances. The surface disturbance, no matter how subtle, modifies the energy balance at the ground surface and if recovery is not fast enough, the excess ice begins to melt, with subsequent subsidence.

Ice wedges are vertical masses of ice which are commonly found throughout the arctic tundra regions and occupy large volumes of the upper 5 to 10 meters of permafrost. Although there frequently is no surface expression of the buried ice mass, the common surface expression of wedges is polygonal ground. The ice wedges occur beneath the narrow troughs which form the outline of the polygon.

The same process of ground ice melting or removal occurs naturally. Figure 4 is an aerial oblique of an arctic coastal lake, showing a deep

Fig. 4. Aerial oblique of arctic coastal plain lake, showing deeper inner basin from which ground ice has been removed, and the shallow shelf surrounding it. (Sellmann et al. 1975)

inner basin and shallow shelf. The inner basin where the ice cake resides is the result of melting of this excess ice, an indicator that the surrounding area contains considerable ice in the near-surface permafrost.

What actually occurs when a vehicle crosses the tundra in the summer? The standing live and dead vegetation is crushed into the wetter substrata. These plant remains soon begin to decompose faster than the neighboring, undisturbed vegetation. This produces a strip of green vegetation in contrast to the drabber-appearing brownish tundra. This drab color results from the large quantity of several-year-old, dead plant remains which stand upright in the tundra plant canopy. Thaw under these so-called greenbelts is generally deeper than in the undisturbed area (Gersper and Challinor 1975). The initial impact of an off-road track, however, is the adverse visual impact. The greenbelts tend to last a number of summers due to enhanced soil and plant nutrient and thermal conditions. The degree of disturbance a vehicle leaves behind depends to a considerable degree upon substrata conditions, particularly moisture, and the frequency of passes. In a very wet, low area rutting of the surface vegetation and peat will occur in a single pass. These areas are now avoided by the Rolligon-type vehicle during the summer.

Figure 5 is a cross-section of a multiple pass and multiyear track in the Barrow area. This illustrates the fact that in a given track there are major differences in depths of thaw. The upper, drier cross-section (a) has the minimal thaw. In the lower, wet case, considerable ice was removed and subsidence and thaw are greater under the track. Also, the surface organic layer was virtually removed.

In Nature, heavy localized grazing by microtines (lemming) or caribou can remove living and dead vegetation. When this occurs over ice wedges, the wedges probably melt more quickly than they would normally. Overgrazing under the snow by small animals can occur due to vehicle compaction of the snow. Around Barrow, it was observed (pers. comm. S. F. MacLean, Jr.) that the snow in snowmobile trails was compacted so densely that the lemmings are unable to cross beneath or graze in the snowmobile track. As a result, the areas adjacent to and between several tracks were grazed heavily, and upon snow melt, a linear contrast in vegetation was visible. I used this example to demonstrate the fact that winter cross-country traffic does leave a visual imprint on the tundra. There are many examples where the trails are seen in the summer to end at a lake's edge and resume on the opposite side; obviously, the trail was made in the winter over snow and ice and the compacted vegetation and resultant greenbelt provide evidence.

The impact of tracked and balloon-tired vehicles on tundra has been the source of several demonstration tests in the Prudhoe area (Burt 1970 a and b). Another vehicle which has been experimented with in terms of environmental impact and performance is the surface effects

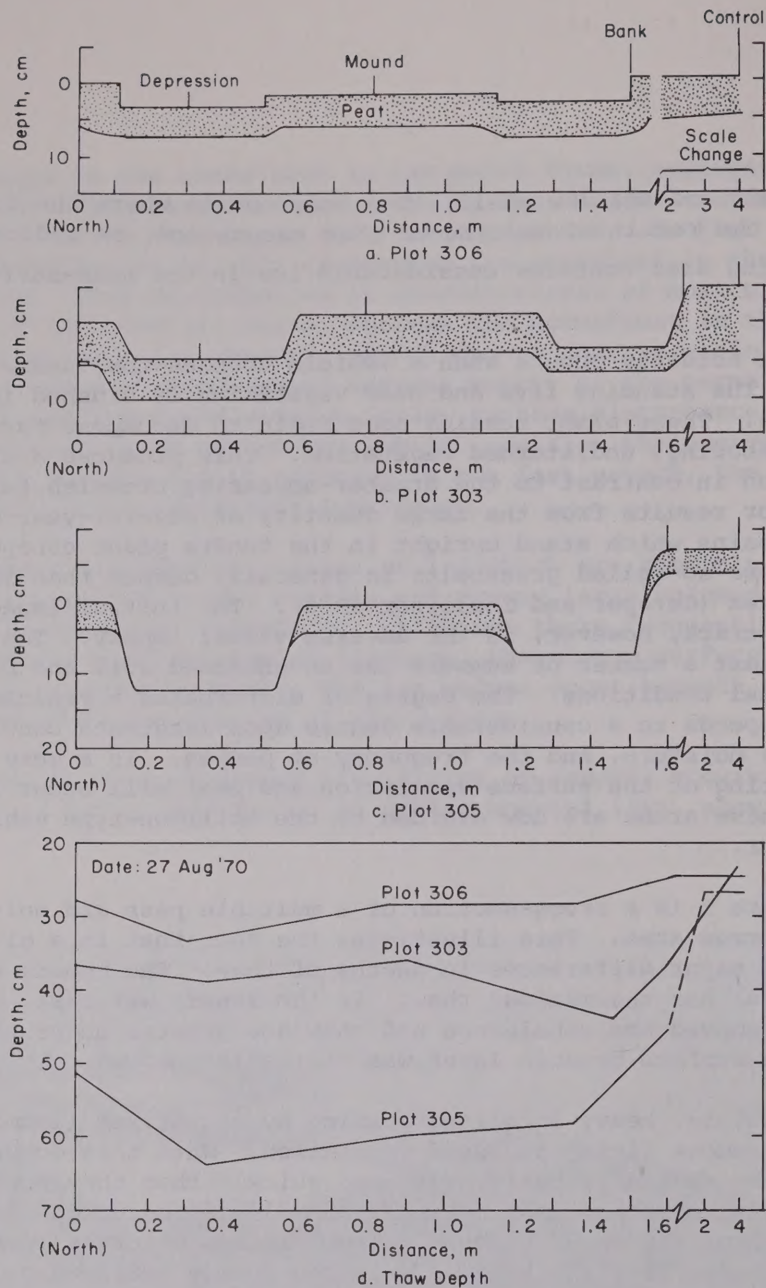

Fig. 5. Variation on thaw depth on old Weasel track at Barrow (see Gersper and Challinor (1975) for details).

vehicle (SEV). CRREL has been involved in a major study at Barrow since 1971 and the results are summarized in a recent report (Sterrett 1976).

The following discussion on the SEV is based on G. Abele's investigations at Barrow on the CRREL multiple-pass test sites and is applicable to other coastal tundras (in Sterrett 1976).

Vehicle speed, number of traffic passes, length of hovering time, and terrain characteristics (vegetation type, water content, microrelief) were the primary test considerations. Traffic tests with a light tracked vehicle (Weasel) were made for comparison. To ascertain and document the ecological effects of the traffic, observations and measurements on the test sites have been made one, two, and three years after the tests.

The effect on vegetation of the SK-5 cushion pressure (0.014 kg/cm^2, 0.2 psi) itself is of no detectable consequence. The disturbance due to the air flow (approximately 33 m/sec; 100 ft/sec) consists of the removal of some loose, dead vegetation; 50 passes with the SK-5 results in the removal of virtually all loose, dead vegetation from the vehicle trail. No apparent damage, such as detachment of sedge or grass blades, moss, leaves, or blossoms, is done to live vegetation. Because of the low air gap ($<$2.5 cm; $<$1 in.), the effect of skirt contact is considerably more serious.

From visual observations, it appears that the degree of terrain degradation is proportional to the number of passes. The rate of degradation decreases somewhat with increasing traffic; for example, 10 passes are not quite twice as serious as five passes, etc. Since degradation is caused mostly by skirt contact, the air gap, not the number of passes, is the governing factor; i.e. the number of passes becomes less significant as the air gap is increased. The visual appearance of the SK-5 path (signature) is influenced to some degree by the direction of travel, especially on wet terrain, due to the bending of vegetation. The trail appears darker than the surrounding terrain when viewed against the direction of vehicle travel and lighter when viewed in the direction of travel. The effect on vegetation increases with an increase in vehicle speed, since the impact force of the skirt against vegetation or terrain microrelief increases correspondingly. No visible effect is produced during prolonged hovering. Removal of some of the dead, loose vegetation around the peripheral skirt occurs.

The extent of damage inflicted on organic terrain by SEV operations depends to a certain degree on the vegetative characteristics. Mosses are less resistant to skirt abrasion than sedges or grasses. Stiff vegetation is damaged more easily than soft or pliable vegetation. The SEV traffic signatures are more pronounced in areas of high water content than in dry areas. The microrelief of the terrain is the most significant characteristic influencing the degree of degradation. Vegetation that survived 50 passes by the SK-5 on level ground may be removed during the first pass when it is on the contacted portion of raised features.

The major impact of SEV operations on organic surfaces is caused by the skirt-terrain contact action, specifically the air gap-microrelief relationship. The number of traffic passes and vehicle speed become significant contributing factors with an increase in microrelief or a

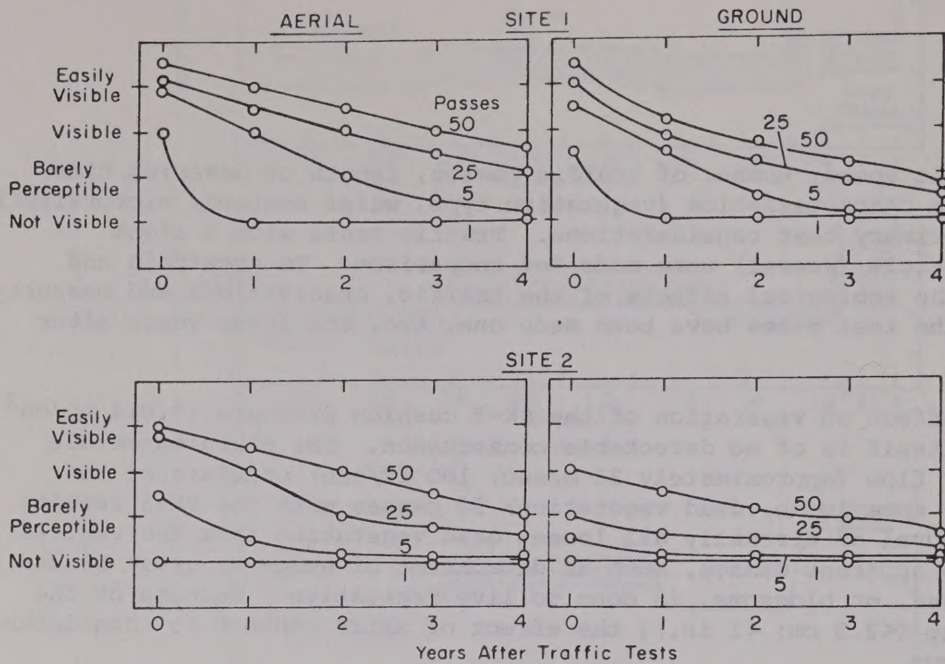

Fig. 6. Relative visibility of SK-5 traffic signatures (from Sterrett 1976).

decrease in air gap. Air escape velocity and vegetative characteristics have a less significant effect, cushion pressure the least.

In comparison with their visual appearance immediately after the tests, the SK-5 traffic signatures on tundra become noticeably less pronounced with time; definite signs of recovery are evident. Significant growth of new vegetation has been observed in areas where damage had occurred due to skirt drag. A one-pass SK-5 trail is not detectable after the first year.

The relative visibility, from air and ground, of the SK-5 test trails at Site 1 (wet, level tundra) and Site 2 (drier, polygonal area) after 1, 2, 3, and 4 years is shown in Fig. 6. It is apparent that 1) traffic signatures are more easily visible from the air than from the ground and 2) traffic signatures on wet, level tundra are more easily visible than those on drier areas having more vegetation and surface relief variations.

The thermal effect (changes in thaw depth) on the vegetative mat in a wet meadow, caused primarily by the removal of the insulating dead vegetation and moss during SEV traffic, is shown in Fig. 7. In comparing the visibility and thaw depth recovery trends, it is evident that while the traffic signature's visibility begins to decrease within a year and continues to decrease at a gradual rate, the effect on thaw depth below a trafficked area continues to increase for a period of one

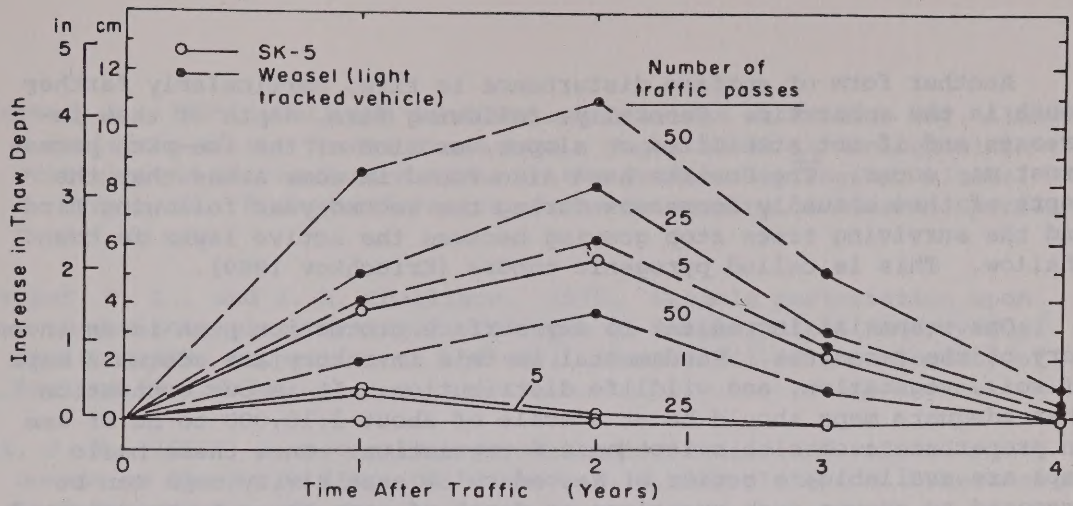

Fig. 7. Effect of SK-5 and Weasel traffic on the thaw depth of wet meadow tundra (from Sterrett 1976).

or two years, and then begins a recovery trend. The rate of recovery of the traffic signature's visibility is slower than that of the effect on thaw depth, once the thaw depth recovery process begins. That is, the traffic signature may remain visible for some time after the thaw depth below the signature has returned to its normal or original depth. It may, therefore, be that the esthetic impact of ACV traffic on tundra is a more serious consequence than the ecological impact (when expressed as the effect on the thermal regime).

Traffic on tundra with a light tracked vehicle has significantly more impact than SEV traffic. On wet tundra (the worst condition), one Weasel pass causes more visual impact than 25 passes with the SK-5, and five Weasel passes are comparable to 50 passes with the SK-5 (Fig. 7).

The question of off-road impact on tundra under snow-covered conditions has been receiving considerable interest recently, particularly in conjunction with winter construction techniques for gas pipelines. Buttrick (1973) reports on the initial ecological results of vehicular traffic across frozen tundra at Prudhoe. A comprehensive review of winter road literature and recommendations for their use are provided by Adam (1974).

Adam classified winter roads as follows: 1) Trails where the snow is simply plowed aside to permit the required access; 2) Snow roads in which the snow is dragged and compacted to the required density; 3) Ice-packed roads where water is sprayed on the snow and worked in to provide added strength; 4) Ice roads formed on lakes or rivers. Each type requires environmental analysis to assess the types and magnitude of damage which may occur. In general, winter impacts of off-road activity are less than summer ones. Canadian reports indicate, however, that heavy and repeated use of winter roads may kill vegetation completely.

Another form of surface disturbance is fire, particularly farther south in the subarctic. Generally, following fire, depth of thaw increases and if not stabilized on slopes, erosion of the ice-rich permafrost may occur. The Soviets have also found in some areas that the depth of thaw actually decreases during the second year following fire and the surviving trees stop growing because the active layer is too shallow. This is called pyrogenic tundra (Kriuchkov 1969).

One essential ingredient to any surface protection plan is an inventory of the resources. Fundamental to this inventory are adequate maps of soil, vegetation, and wildlife distribution. It is our contention that adequate maps should be at a scale of about 1:10,000 to be of use in proper route or site selection and regulation. Once these basic maps are available, a series of secondary or sensitivity maps can be prepared to answer such questions as depth of snow cover to be expected, areas of high lichen cover, location of unique ecological sites, areas more or less susceptible to oil spills or summer traffic, etc. Such an approach has been undertaken at Prudhoe Bay, building on the mapping already reported (Webber and Walker 1975; Everett 1975). These detailed mapping efforts are not the only ones required. Mapping from satellite imagery is proving extremely useful in classifying large areas and showing their seasonal variations (Sellmann et al. 1975, for instance). Additional recommendations on mapping will be forthcoming in Wednesday's sessions.

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session two

CHAIRMAN: Dr. Max Brewer, Chief Environmentalist and Scientific Adviser for the Office of Naval Petroleum and Oil Shale Reserves
Anchorage, Alaska

--continued on next page.

ORV Use on State Lands

George A. Hall

ABSTRACT
The kinds of ORV's and their uses are growing. Regulation by state agencies generally has been to permit ORV use where it is not likely to damage state property. The State Fish and Game Department must protect fish and game. All of us must help protect flora and fauna and their natural balance as well as preserve cultural remains. During summer and winter, highway rights-of-way are heavily used by ORV's but increasing Alaska traffic is likely to force them into the back country. Regulatory needs include the following: 1. Noise control; 2. Permit procedures and enforcement; 3. Registration of ATV's and ORV's, speed and driver age limits, and identifying decal display. The public needs to agree on the cost it is willing to pay for the operation of ORV's.

I read that the ORV is already an American institution, and although we focus on the snow machine, the field includes trail bikes, dune buggies, and four-wheel drive cars. New, larger track vehicles and rubber-tired swamp buggies must also be considered. Of most importance is an awareness that the test of what we do will be tomorrow, when a new exotic machine appears--one-man helicopters, airfoil rafts, rocket packs--each seeking inroads into the fragile back country for some reason. Not all impacts are unacceptable; not all uses are acceptable. There's the dilemma--which is which?

The discussion also has a quality of the looking glass from Alice

in Wonderland. Snowmachines are recreation vehicles here in Anchorage, but transportation in the Bush. They are used for support to recreation hunting in some places and for subsistence support in other places. The Bush communities will not support restrictions on ORV's because they would be limiting their own flexibility.

I do not feel that state land can be segregated into the managing divisions very simply because the common denominator of all state agencies is responsibility for the state's resources. Land is possibly the most fundamental resource, and in Alaska much of it is very fragile. It is also my opinion that there is very little difference between state land and land managed by federal agencies in Alaska. I have seen few of the artificial lines laid by man on maps that were easily found on the ground. We all have a common charge to treat the land with sensitive care so that it can support the crop of a future.

How do the various state agencies treat the ORV? Are there major differences in philosophies?

State agencies in general permit ORV use where surface damage is not likely to constitute damage to state property.

Within state park areas, the use of ORV's is permitted only in areas and on trails designated by the director. In the Chugach State Park, five major drainages are open to winter activities based on adequate snow cover. In Nancy Lake Recreation Area all but the northernmost portion of the park is open on a trial basis. There is a developing feeling that enough trails should be developed to respond to the demand, but impacts should still be controlled.

No areas are designated for summer ORV use in any state park. Off-road vehicles are treated as standard vehicles in all parks.

Protection of flora and fauna and preservation of the natural balance in parks is a responsibility of all of us. Another often overlooked responsibility is the protection of cultural remains. This translates into "archeological remains" to most people, but the introduction of many new devices, including maneuverable riverboats, has made visiting the remote cabins or abandoned villages and towns exceedingly easy.

In the latter case, it has been far easier to identify the problem than take a case to court. It may be within the conscience of each of us to protect these relics of a remarkable frontier area. This must be a role of the organized groups of users of ORV's.

The Fish and Game Department also constitutes an agency with recreation responsibilities, but it is charged with protecting and preserving the fish and game resources. Limiting access to hunting areas does not prohibit the entry of ORV's, but makes it illegal to use them for hunting. Therefore, a hunter is not able to use an ORV, but a nonweapon-carrying

person can use an ORV in the same area. Some coordination of the two sets of regulations seems desirable.

Highway rights-of-way, referring to "off-improved-road-surfaces," are heavily used by both summer and winter ORV's. Freshly seeded slopes or other fragile ground cover is especially vulnerable to scarring. The increasing interest in highway beautification will undoubtedly make stronger control necessary. The increasing traffic in Alaska will begin to limit permissibility for ORV use in rights-of-way and force the people into the back country again. Summer bike paths seem unlikely to be a useful alternative surface.

Off-road vehicles are also commonly used for industrial development and exploratory work. While the use of these vehicles is permitted, the damage to the terrain is carefully considered and the period of use is carefully regulated. Overstaying the permit period can result in claims for damage. But what does that mean? Can you heal the scar on an alpine meadow? Can we close an archeological midden unknowingly torn open by an off-road vehicle?

The commonest assumption is that most damage is from snowmachines, but motorcycles and trail bikes have considerable impact on soil, by compacting, displacing, or eroding it. The balance of natural mixture is then blown away by wind. But it is fairly stated that the recreation snowmachine takes a beating, possibly for problems shared by the all-terrain vehicles used by nonrecreationists.

To propose regulation or control requires that we understand the problem.

1. Refusal to adequately control the noise level has been a mistake by the manufacturers, for this transforms wilderness buffs into raging demons and a quiet cabin dweller into a jumble of nerves.

The decibel level has to be restricted to below 80 decibels and regulatory intent must be enforceable.

2. The failure to control freewheeling off-road enthusiasts has resulted in soil and vegetation damage in certain areas. Whether the vehicle was for recreation or otherwise, the responsibility remains on the land manager to assure that the user or user group does not take more than its fair share.

Regulatory enforcement of use of specific or developed trails, routes, or areas must be established. Permit procedures must be established and enforced for both recreationists and industrial or exploratory users. Failure to adhere to permit terms should be enforceable at the field level. Courts must cooperate.

Area closure to snowmachines should be effected by field orders

where soil and vegetation damage is possible. Field managers should be capable of making this judgment.

Land managers should not be pressed to accommodate any and all new devices concocted by industry. We have only one land and the careful husbandry of this resource is mandatory if we are to leave something for tomorrow.

3. The ATV and ORV are exempted from the definition of vehicle; therefore, several objectionable results have occurred. Speed limits do not exist. Driver age limits are not specified. Licenses are not required. Registration is called for but state park rangers found two years ago that fewer than 50 percent of users had paid the registration fee or carried a sticker.

The importance of recognizing the skill required to operate a machine is mandatory, and age restrictions should be applied. Stringent enforcement of registration and display of an identification decal are urgently needed.

Through these devices the ORV can begin to find a degree of acceptance, although we should all agree here and now, it will be grudgingly given. Our challenge is not to solve yesterday's problem, but to see tomorrow clearly enough to avoid the same pitfalls and to find a way to bring the benefits to people at a cost we will all agree to accept.

ORV Use on National Forests

Clay G. Beal

ABSTRACT
A summary of policy and regulations pertaining to off-road vehicle use on National Forest land is presented. A case history of off-road vehicle zoning which has been completed for the Kenai Peninsula portion of the Chugach National Forest is included. This zoning was accomplished through considerable public involvement and coordination with adjacent landowners. It became effective August 1, 1975.

Although my talk is primarily directed toward the recreation ORV, I thought I might lead out with just a brief review of the other types of uses on National Forests that require surface protection and cover some of the regulations that apply to them.

There are essentially four broad categories of uses of National Forests that result in a need for surface protection.

1. Special Uses. These range from ski resorts to packer permits, from summer homes to road construction, and everything in between. Occupancy of National Forest lands or use of National Forest lands to make money requires a special use permit, included in which are clauses which state what must be done to protect the surface and penalty for not complying. The clauses are backed by federal regulations.

2. Mining. New regulations came into effect a year and a half ago

which require an operating plan for all mining or prospecting activity which will cause significant surface disturbance. This operating plan is an agreement between the Forest Service and the miner to protect the surface resources and rehabilitate the site when he is through. A bond may be required to assure that the agreed-upon rehabilitation takes place. These are federal regulations and, therefore, must be complied with.

3. Timber Sale Contracts and other formal contracts, as for road construction, trails, timber stand improvement, etc. These are made up of standard national clauses and local clauses which require performance and give direction for a variety of things, including surface protection. Performance bonds are required for these also.

4. Recreation Use. This is an area where considerable conflict lies and an area of much discussion and action in the past 10 years throughout the country. The Forest Service has been able to regulate ORV use in the past by federal regulations. The code allowed us to regulate for several reasons:

1. To protect the resources of National Forest lands.

2. To promote safety of all users of those lands.

3. To minimize conflicts among the various uses of those lands.

These regulations can get quite specific in that a variety of uses can be allowed or prohibited.

Most National Forests have considered the need for regulating uses of one sort or another, and most forests have effected them. The Chugach's first closure of a trail to motorized use was in 1970, when the Resurrection Trail and other trails were regulated. The Turnagain Pass area was closed to ORV use in the summer shortly thereafter.

The federal regulations give the authority for such closures to the Regional Forester who has, in most cases, delegated this to the Forest Supervisor.

Most of this type of regulating was done on a case-by-case basis, where surface damage was taking place or was about to take place, or where conflict between users was the greatest. Where wilderness classifications regulated use within the classified area, many areas adjacent to them were regulated to minimize conflicts or make administration of the use within the wilderness easier.

Classified wilderness is also regulated by specific wording in the Code of Federal Regulations.

The Code of Federal Regulations defines ORV as motorized vehicles.

It excludes motorboats; excludes vehicles for official or emergency use; excludes authorized use under permit, lease, etc.

We have been administering the National Forest with federal regulations which authorized regulation of ORV's. Our policy was that ORV's use was legitimate and unless a closure was effected, the National Forests were open for use. Regulation of the use, as I mentioned before, was possible to protect the resource, for the safety and welfare of the user, or to minimize conflict.

On February 9, 1972, President Nixon issued Executive Order 11644, which directed each federal agency to ensure that the use of ORV's be controlled on the lands it administered. On February 28, 1973, proposed regulations on National Forest system lands were issued by the Assistant Secretary of Agriculture and published in the Federal Register on March 2, 1973. A Draft Environmental Impact Statement was prepared. The public and other agencies were invited to make comments by May 1, 1973. The final version was published in the Federal Register on September 25, 1973, and became effective October 20, 1973.

The EIS listed two alternatives:

1. Immediate prohibition of ORV's, followed by study.

2. Continued recognition of ORV use and provisions for it. Study and identification of areas where use is and is not acceptable and imposition of necessary controls.

The second alternative was selected.

Administrative instructions set December 31, 1976, to complete the needed zoning on all National Forest lands.

To get this started on the Chugach National Forest, we decided the area most used, where most conflicts and potential conflicts were expected, was where we should begin our studies to regulate. Although the Copper River Delta area is very sensitive, with swans, moose, geese, oil and gas, etc., we determined that we should begin on the Kenai Peninsula.

At our request several organized groups representing the interests of both motorized and nonmotorized users of the Forest presented proposals. These proposals were later used in formulating original zoning proposals that were presented in public meetings. We decided to include horse use at the same time, since that, too, is an established use that can result in surface damage as well as conflict with other uses.

In January 1974, a study plan was prepared for completing the zoning on the Chugach National Forest portion of the Kenai Peninsula. Copies of the study plan were sent to representatives of the other government agencies in February 1974. Copies were also sent to more than 90 key

interested individuals and groups. During the summer of 1974, field exams were made by our personnel of all open trails and roads on the National Forest on the Kenai. These field exams considered past and potential resource damage as well as the physical properties of the facilities.

With the input from the various individuals, groups, and agencies, we prepared a zoning proposal. In December 1974 and January 1975, we presented it to representatives of the Fish and Wildlife Service, Chugach State Park, Bureau of Land Management, National Parks Service, Greater Anchorage Area Borough, and Alaska Department of Fish and Game.

Public meetings were conducted during February, March, and April 1975 in the form of open house discussions at Cooper Landing, Seward, Girdwood, Soldotna, and Anchorage (total of 11). At these meetings the people attending were asked for oral comment and then urged to follow up with written comments. A form was provided that asked for ideas in specific areas and left plenty of room for general input. We got a total of over 200 written replies as well as the benefit of hours of discussion in the meetings.

As the result of the input from these meetings, the final zoning decisions were made in June 1975, and August 1, 1975, was the date set for them to go into effect.

The regulations were quite simple in some areas and more complicated in others. Most areas of the Forest were closed to cross-country ORV use in the summer, and most areas were open to snow machines in the winter. Trail regulations varied both in summer and winter. Generally, in the winter regulations applied to areas, while in the summer, they related more to individual trails.

Problems followed the zoning in informing the public of what we did and then posting the information on the ground. By the time the snow got deep enough for snowmobile use, most of the signs were up.

Our next effort is already under way and will be handled similarly in the Copper River Delta Area.

I could go on to discuss the administrative problems related to enforcement of the regulations, but I'm sure you can appreciate that we aren't a police force and that we aren't out on patrols to catch people.

Procedurally, we do have a system that works fairly well. Since zoning is under a federal regulation, a violator can be cited to appear before a federal magistrate and/or pay a fine. A Forest Officer can issue the citation and the person cited then has a choice of appearing before the magistrate to plead his case or of posting pay bond by mail. A bond schedule has been determined for most of the common offenses and the amount is written on the citation form. If he chooses not to appear, his bond is forfeited as a fine for the offense.

In closing, I want to restate that the Forest Service considers a variety of uses legitimate. Many of these uses do conflict. By policy and direction we are committed to consider all of the uses and to regulate where it is needed to protect the resources, provide safety for users, or to minimize conflicts among users.

ORV Use on National Resource Lands

Gerald W. Zamber

ABSTRACT
Off-road vehicle activity falls under the broader category of the Bureau of Land Management's surface protection responsibility. Surface protection includes such things as fire control, watershed control, and vegetation or habitat protection. It includes any activities that by their conduct could cause surface disturbance. This presentation describes the surface protection problems in the Denali area of Alaska and briefly describes the evolution of ORV regulations by the BLM.

The Bureau of Land Management's ability to protect the surface values of the land under its jurisdiction is directly related to the following four factors: 1. Federal or state statutes and federal regulations available to the Bureau; 2. The quality, interpretation, and applicability of these laws and regulations; 3. Availability of personnel to administer the laws and regulations; and 4. Public concern and concurrence with surface protection regulations.

It is one thing to be told to protect surface resources and quite another to be physically and legally able to require or enforce consideration for surface protection. This is especially true with respect to general public use of an area. Individually, people are concerned for the environment. Individually, however, they do not want to be restricted in their use of off-road vehicles and probably do little damage. Collectively, they can do a great deal of damage, which will be shown to some

extent in a slide series.[1]

Use of public lands for ORV activities has increased steadily in recent years. In 1971 it was noted that more than five million recreational off-road vehicles were in use. They were causing severe surface disturbance, conflict with other uses, resource loss, and safety problems.

Most of you have seen the TV ads showing how these vehicles can run over brush, plow through mud, climb straight up hills, and even puddle across rivers and lakes. Many of the vehicles are capable of doing all these things, but the real problem is not what they can do, but rather what people make them do.

In 1972, the President signed Executive Order (E. O.) 11644 to provide for control of ORV's on public land.

--The E. O. essentially defined an ORV as any vehicle.

--It said that with full public involvement, areas would be designated as to their ability to tolerate ORV activity.

--It said that as far as possible, agencies could enter into cooperative agreement with enforcement agencies to regulate this program.

As a result of this E. O., in December 1972 a BLM briefing paper was assembled and sent to BLM state offices. In the paper, the E. O. was reiterated and some points were "clarified."

Point 4 of the briefing paper stated the following:

1. "BLM lands will remain open, closed, or restricted, as they are now, until they can be put through the BLM planning system. BLM regulations will apply to all vehicles except those used in mining or prospecting under the Mining Law of 1872."

2. Maps will be made for the public. (A real problem in Alaska is that the public can't tell who owns what, on maps as well as on the ground.)

3. Control or enforcement awaits passage of the BLM Organic Act.

In 1973 regulations dealing with ORV use were proposed in the Code of Federal Regulations (CFR). BLM said the regulations did not apply to exploration or development of minerals or oil or gas geophysical operations on areas closed to ORV use. Public comments on these regulations

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[1]Because of printing limitations, color slides used by Mr. Zamber in his seminar presentation are not reproduced here.

were 56 percent in favor of keeping lands open until closed, 44 percent in favor of closing lands until they were opened, and 85 percent opposed to mining exceptions stated in the proposed regulations.

Because of public comment, the preamble to the regulations published in 1974 indicated that the reference to exceptions for oil and gas geophysical operations and for mining operations in closed areas would be deleted, since geophysical operations would be under lease or permit and as most areas are open to ORV's, the regulations would not usually apply to mining.

(What this says to me is that areas open to mining under the 1872 Mining Act and open to ORV's will not suffer under these regulations--a difficult situation for those responsible for surface protection. We would prefer a system that provided opportunity for mineral development, with stipulations controlling surface degradation rather than the closed-or-open alternatives, and more important, regulations that apply equally to <u>all</u> ORV users. Also, ORV regulations should be found under the CFR 2000 series, Land Management, rather than only in the recreation regulations of the CFR 6000 series.)

The National Wildlife Federation then filed suit against the proposed regulations. The Federation suggested that areas should be closed until studied and, with public input, be evaluated through the BLM planning process. They also felt that the Environmental Impact Statement (EIS) was inadequate because it covered recreational ORV use only.

As a result of the suit, proposed amendments to ORV regulations were forwarded to the field in September 1975 for review. Field comments as discussed above were transmitted to the BLM Alaska State Office, but final regulations have not as yet been published.

Let's look at a place that has extensive ORV activity--the Denali area. This area includes about two million acres, stretching from Paxson Lake to Cantwell on both sides of the Denali Highway. Some characteristics of the area follow:

--400,000 acres are in a National Archeological District.

--It has grizzly bear concentration areas.

--It has relatively heavy moose hunting pressure.

--Parts are used by the Nelchina caribou herd.

--Several potential wild and scenic rivers run through it.

--It is in a critical soil permafrost condition, with high ice-content silts frozen at about 31 degrees F.

--It offers excellent sport fishing opportunities. Its rivers are primary contributors to the Gulf of Alaska commercial salmon harvests.

--Scenic beauty and variety are readily accessible to the traveling public.

--The area has had some mineral activity and may have further potential.

--The trans-Alaska oil pipeline has had impacts on area use, and the area is a potential site for the proposed gas pipeline from Prudhoe Bay.

[The following comments on the uses and problems of the Denali area were illustrated with color slides.]

One thing about Alaska is its variety, and people like to enjoy the wilderness in a variety of ways. Some people enjoy strolling down a misty trail to their favorite fishing hole; others would rather ride. Some people will use existing trails for vehicular traffic; others like to break their own trails. Some people enjoy the bush and keep it clean as they found it so that others are not offended; others lay claim to an area and treat it as if they owned it. Some cultural values are identified and protected to provide information about our past cultures; some house pits are used as motorcycle jumping ramps.

People use every available means they can to enjoy the back country. Some fly to where others drive; some use boats; some walk.

Should people be allowed to use these areas? Of course, but do we need highway cloverleaves in the tundra? If one person uses an area should others be restricted?

What are some solutions we believe are necessary? With some forethought, trailheads and trails can be laid out to be esthetically pleasing. Use can be geared to the time of year when surface is least likely to be damaged.

Vehicles can be made to standards so that they will least affect the land, and summer trails can be laid out to avoid areas of fragile soils and vegetation.

We need to gather better information on high-use areas so we can make better public use plans.

To obtain better information, last year we contracted with Colorado State University to do recreational interpretive work in the Denali to help identify best uses and how to develop them. We are also studying recreational ORV use in this area through a contract with the University of Alaska.

We need regulations that control all activities--not just recreation--with equality. We need the personnel as well as the regulating authority to follow through with our plans.

Right now, our only alternatives are to leave an area open to any use or completely close the area under emergency regulations. We don't like to close areas. We'd rather see the areas used, but without damage to the resources. This can only be accomplished in time with the backing of a BLM Organic Act and properly developed and applied regulations.

As time goes by and more people come to Alaska and development continues, surface protection will intensify unless proper management tools are available to plan, develop, and control ORV use on public lands.

An Overview of Arctic Exploration Activity

M. Thomas Dean

ABSTRACT
Before 1968, the Bureau of Land Management had few laws and regulations to prevent surface disturbance from geophysical operations on the North Slope. Some signs of disturbance remain from those days. Cooperating with the Alaska Oil and Gas Association, the BLM has guidelines to give industry when notices of intent are filed. Continued cooperation and further regulations are needed to protect surfaces on the North Slope

Before 1968, the Bureau of Land Management Fairbanks District was not in an enviable position in regard to its responsibilities on the North Slope. Although BLM administration extended over the North Slope lands, we had few laws and regulations under which to perform surveillance, and no guidelines to give industry. At that time, however, few people were concerned about what happened on the North Slope. It was just a stretch of frozen country where polar bears and caribou roamed.

I will illustrate with a few slides some of the things that occurred before 1968.[1] This slide, taken in 1968, shows what happens when you have no guidelines or agreements and the workers consider the land just a piece

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[1]Because of printing limitations, color slides used by Mr. Dean in his seminar presentation are not reproduced here.

of real estate where they go to do a job and then get out. The trail shown is not a winter trail; it is a seismic line, built in 1966. The trail was made by a Caterpillar tractor operator who put the blade down and traveled across the terrain. The work was done in the spring when the surface was fairly soft. What probably happened was that someone sent to work on the North Slope stayed too long. The ground started to thaw, snow began to melt, and they had to get out fast. To make the trip out easier, they decided to move the soggy vegetation aside and run the cat over the frozen ground. Today, instead of just a cat's blade wide, some of the trail is 10 to 20 feet wide. In places it is 10 feet deep instead of only 9 inches.

Along with some old trails and shot lines, some litter may still be seen. So ubiquitous are the 55-gallon oil drums that they have been called the Alaska State flower. If geophysical workers had no reason to save the drums when they had used the contents, they dropped them wherever they were. In camps, they stacked up the drums, but in the field, they often dropped them off rigs as they moved across the tundra. There was little awareness of how scarce unspoiled wilderness land would become.

In the winter of 1968, the Bureau of Land Management and the Alaska Oil and Gas Association got together to write a set of guidelines for oil and gas exploration on the North Slope. Before the guidelines were established, we saw scenes like this. Human waste, crankcase oil, and partially burned camp garbage were dumped on the ice of a pond, with the idea that when spring came, the litter would sink. Unfortunately, a lot of the garbage floats and ends up on shore. Debris floating in a lake makes landing a floatplane very interesting. This kind of trash dumping went on in the early days simply because no one thought about the consequences.

Summer field camps also brought problems. Few crews returned to the same area after one year, and they buried their trash without burning it. Burial pits were dug in any convenient sandbank or wherever it was easy to dig--out of sight, out of mind. Within a few days after the garbage was neatly buried, foxes, bears, and ravens arrived to dig it up and scatter it about.

Another little flower that "blooms" along Alaskan lakeshores is the 5-gallon gas tin much beloved by guides and aircraft pilots.

In the early days of oil and gas activities, well locations used small amounts of gravel, and there was little concern about the surface. Geophysical camps were set up on the ice on ponds and lakes. Because the ice was level, the crews didn't need to block up the rigs during the week or two they camped while running seismic lines in the area. They, too, dumped their trash on the ice, assuming that at breakup it would disappear. Crankcase oil and other petroleum products were discarded on the ice, as well.

Equipment used to build the shot lines left its mark on the tundra. Often, multiple passes were made on the same track. To make the ride on the cat smoother and faster, operators would put down the blade, level off the tops of the sedge tussocks, and clear away the snow. In spring when it was time to stop work and store the equipment for the summer, the crews would park all the machines in one area. They didn't bother to block the heavy equipment, and during the summer, much of it settled into the permafrost and vegetation. Summer crews were sent to rehabilitate the trailers, drills, engines, and other equipment and get them into shape for the next winter's operation. Since work pads were not put down to protect the permafrost, these crews usually spent the summer working in the mud.

Snow roads generally were snow roads in name only. To build them, cat operators usually pushed the snow out of the way, knocked the tops off the tussocks, and sometimes filled in the holes with a little snow dragged from the berms. If the job was rough, they often brought in a grader to level the trail.

At our meetings with the Alaska Oil and Gas Association, we often talked over these problems and wondered if there weren't better ways to do things. One recommendation that came from these talks was that tracks for seismic lines be staggered so the vegetation mat would not be compacted and torn up as badly as when multiple passes were made on the same track. There has to be one primary line where the charges are set off, but most of the equipment can be run parallel to the primary line.

We also agreed that cats with blades should be kept off the North Slope. Blades seem to have a strong affinity for the ground; the cats can't seem to run with the blades up.

Placing airstrips on the lake or pond ice is ideal; all the crews have to do is push the snow off the ice and they have a nice level runway. Our stipulations now prohibit setting camps on the ice, however. Nothing except the runway is on the ice. Fuel and equipment storage is pulled back onto the upland.

Most of our guidelines are just that--guidelines. We don't have regulations for directing operators or for forcing them to operate in a proper manner. When industry comes to the BLM with a seismic operation proposal, they file a Notice of Intent. This tells us in which townships and ranges they want to operate. When we get the Notice of Intent, we give industry guidelines that we recommend they use. The operators are aware that if they follow these guidelines, they can operate with little damage to the surface. The only enforcing action we can take at this time is trespass action.

I should like to emphasize that our success on the Slope and in other areas would not have been possible without good working relationships with

the Alaska Oil and Gas Association and the geophysical operators. A number of our guidelines have come from the Association staff.

A typical present-day well location is shown [on the slide]. The BLM and USGS operate jointly on well locations, and these days, gravel pads are used. Right now, gravel is the cheapest material to use for insulating the surface to prevent heat transfer from the rig to permafrost. Gravel leaves a smooth surface and is easily policed after the operators leave. It may become more expensive, however, and we may need to find other ways to insulate the surface.

We are going to need more cooperation and be stricter with regulations if we are to continue geophysical operations and protect the land. Industry and government have made good strides in the past. I hope we can continue to work together so we can keep the North Slope and the rest of Alaska looking the way they should.

Seismic Activity in a Northern Environment--Winter Operation

Lonnie D. Brooks

ABSTRACT
Thirty years of experience in winter seismic work in the Arctic have taught the geophysical industry many lessons about the non-destructive use of the land in the northern environment. Equipment and procedures have evolved with a view not only toward increased efficiency, productivity, safety, and quality, but also toward protection of the environment.

The geophysicist with his crew of men and machines is part of the leading edge of the petroleum industry's thrust into a new petroleum province. Drilling for oil is expensive. About three years ago Imperial Oil Limited, the Canadian affiliate of Exxon, drilled a well in the Mackenzie River delta of the Northwest Territories, an area much like Alaska's North Slope. By the time the hole was completed, including preparation of the surface, the well cost Imperial a reported $10 million in direct cost. That particular well was nonproductive. That is a cost of which all of us bear some part. The task given to the geophysicist is to reduce the risk involved that leads to that needless expense.

The seismic method is only one of many tools available to the geophysicist in accomplishing this task. But it is the most widely used, is the one involving the most persons, and thus, is the one most likely to be encountered by people outside the industry and to have an impact on the environment.

As far as Alaska's Arctic is concerned, geophysical work started on NPR-4 in 1944, in the waning years of World War II when the country was searching for secure sources of petroleum to support the war effort. For about 30 years since then, the seismic industry has been more or less continuously involved in searching for new reserves.

Most of the work in the Arctic has been done during the winter, because that is the time when it is easiest to move around up there. It is also the time when the ground is frozen solid and the least susceptible to disturbance. In the picture on the screen[1] you see a typical winter seismic camp parked during the summer on a raised gravel pad. It is stored there ready and waiting to go to work when winter comes.

Many different types of vehicles have evolved during the industry's 30 years of arctic experience. Some have been developed for the industry; others have been adopted from other industrial or recreational sources.

In this picture is an early tracked-type carrier with a seismic drill mounted on it. On this unit, steering was accomplished by turning the tracks. This next picture shows another of this type, this one used for supply. Neither is in use any longer.

This is a snowmobile. It is a relatively lightweight, fast-moving vehicle, ideal for light cargo or personnel. It uses tracks for propulsion and weight distribution and front skis for steering. Tracks are not separately braked for turning.

As the loads get bigger, the carrier and its running gear get bigger. In the center of this picture is a drill mounted on a tracked carrier. Vehicles like this evolved for purposes of mobility and ground protection; the two goals are not incompatible.

This is a fairly recently developed flat track carrier with mounted drill. The flat track seems to be a much better design environmentally, with very little loss in towing traction.

Parallel with the development of new track systems, large rubber-tire systems have been developed. Here is a picture showing an entire crew's units mounted on wheels. These big tires are called Terra tires.

To give you an idea of the size of the tires, here's a shot of a man kneeling by one, putting air in it. The tires are 4 feet wide and about 5 feet high.

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[1]Because of printing limitations, color slides used by Mr. Brooks in his seminar presentation are not reproduced here.

For fast, breezy mobility, the one-man open snowmobile is hard to beat.

Camp transport has changed and is changing. One contractor's version of the best method is illustrated here, although the sleigh runners in the picture are narrower than the 12-inch-wide runners now in use.

At this point I should like to say a few words about our methods. Seismology in its most widely used form does not give any indication directly of the presence of oil or gas beneath the surface. What it does do is give the interpreter an idea of what the rock structures are like. This allows the geologist--the exploration manager--to make an educated guess based on previous experience of where petroleum has a chance to accumulate. To reduce the risk in that guess, the accumulation of as much data as possible is desired. Reconnaissance survey work usually involves straight-line traverses of from 20 to 70 miles in length, with samples taken at intervals along that traverse with seismic waves. The best method available for increasing the amount of data is to multiply sampling. We now use 12- and even 24-fold methods. This multiplicity has been accomplished without increasing the number of repetitive vehicle passes. It has made crew size grow and camp size, as well. Crews now are typically 40 to 50 persons and sometimes even more.

Continuing with the pictures, for very heavy loads this vehicle was developed for the seismic industry. It is shown here in the manufacturer's test yard. It has six Terra tires for load distribution and nondestructive traction.

This picture shows the vehicle with a drill mounted and a canvas shroud enclosing it to protect men and equipment.

Procedurally, the camps are moved frequently--usually every day--to keep vehicle traverses to the worksite to a minimum. This maximizes efficiency and minimizes surface wear. Actual field techniques for the drilling and loading of holes and for placement of recording instruments have been designed to minimize the necessity for repetitive passes over the same ground while at the same time increasing the number of samples of data from the same subsurface location that are extremely critical to the high technology computer.

To sum up, the geophysical industry is continually working with regulatory agencies, its client oil companies, and its suppliers of equipment to develop methods and equipment that are more efficient, more productive, and less likely to damage the land. The goals of the regulatory agencies do not have to be incompatible with those of the seismic industry.

Seismic Activity in a Northern Environment--
Summer Operation

J. L. Hudson

ABSTRACT
With the advent of low ground-bearing-pressure-tired vehicles, land seismic activity in the summer months is now possible in many parts of Alaska. For broad reconnaissance-type seismic programs, the development of small portable recording systems offers hope for man to utilize the more favorable summer months for mapping underground structures.

Until recently seismic activity on the delicate tundra was limited, with few exceptions, to the months of the year when the ground was frozen. Today with the advent of low ground-bearing-pressure-tired vehicles it is possible, in some parts of Alaska, to conduct land seismic surveys during the summer months with minimal disruptions to the tundra. A seismic survey was conducted in the Bethel Basin in the summer of 1974 utilizing all low ground-bearing-pressure-tired vehicles.

In case some of you are wondering about this slide[1], this picture was not taken in the Bethel Basin. I was unable to obtain the slides of the summer's work in Bethel so the slides were borrowed from the Bureau of Land Management (BLM).

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[1]Because of printing limitations, slides used by Mr. Hudson in his seminar presentation are not reproduced here.

This slide shows a Rolligon Model 660. I would like to call your attention to the wheels of this model. They are 54 inches high and 68 inches wide. All the vehicles were designed so there was a ground-bearing pressure of between 3 to 3-1/2 pounds per square inch. Some of the vehicles were four-wheel drive, some were six-wheel; some were even eight-wheel drive.

Generally, the equipment performed very well. There were a few minor problems such as those associated with crossing small narrow streams with sharp banks. Also, the center of gravity of the vehicles was a little high, making it difficult to cross slopes at an angle. The vehicles also encountered problems in brushy terrain because their tires are vulnerable to brush. But in an area such as the Bethel Basin, the equipment worked well.

Disturbance to the surface was minor. The work was monitored closely by the BLM throughout the area. In low-lying areas the tall grass was laid down as the tires ran over it. The grass did not immediately spring back, and from the air, it appeared that surface damage had occurred. After a period of time, however, the grass did spring back.

It is important to note that to prevent rutting in these low-lying areas, the vehicles did not follow one another or make repeated passes.

Early in the 1975 summer, this area was inspected from the air and the only notable difference was that the grass seemed greener in the vehicle paths.

This slide was taken in the Bethel Basin in the spring of 1974. This is the conventional Terra tire which, in this instance, is 42 inches wide. This was sufficient to give the vehicle good flotation. In the next two slides you will see some tracks that were left by this Terra tire. It was before spring breakup and there was a light snow on the ground. The next picture was taken during spring breakup and the only tracks you see are the cleat marks.

The Bethel Basin is a large flat stretch of land lying in the western part of the State. The soil is such that the permafrost has much less ice than that on the North Slope and as a result very little erosion occurs.

An interesting discovery during the summer's work was that the tundra has remarkable ability to heal itself. An exploratory well was drilled in 1961 and a rig was set up. Conventional 18-inch wide Rice & Cane tires mounted on industrial tractors were used to haul supplies 2 miles over land to the project. You can imagine the ruts that were caused at that time. Today, although you can see the scars, the tundra has healed.

This is where the boat and barge offload the supplies to be taken

by tractor to the rig location. The next two pictures are from the rig location. You will notice there that the tundra has grown back over the ruts, and you cannot detect any disturbance from the air except the ruts. This shows a view from the rig at a different angle.

In Alaska many basins have never been surveyed by the seismograph. A broad reconnaissance-type seismic program would determine if further exploration work is warranted in these unsurveyed basins. A highly portable seismic crew could accomplish this reconnaissance.

Today, industry has 24-channel instrument systems that weigh approximately 150 pounds and occupy about the same space as five ordinary suitcases. A small backpack portable auger drill has been utilized successfully to drill holes for explosives in many inaccessible parts of the United States. All the equipment needed to conduct a survey would go into a Bell 205 helicopter. You must keep in mind that an operation such as this would be for reconnaissance only.

As more onshore areas of Alaska open for development there will be places where other special skills or equipment are required. Given the proper economic environment, industry will find a way to do the job with minimum disruption to the surface.

Vehicles and Roads for Petroleum Exploration

Mickey L. Sexton

ABSTRACT
To meet transportation needs for North Slope petroleum exploration where inadequate or no road systems exist, specialized load-carrying equipment has been developed. Each vehicle type has unique advantages and limitations and is used where travel needs are small. For heavier use, snow roads are built.

The search for petroleum resources often requires heavy equipment transport and travel within areas of Alaska where no road systems exist. Existing roads may not lie in a direction that meets the rigid requirements of today's sophisticated exploration techniques.

To solve the problem of moving equipment within roadless areas and to prevent excessive environmental damage, the transportation industry, with cooperation from permitting agencies and the petroleum industry, has developed specialized load-carrying equipment. These include air-cushion vehicles, track-mounted carriers, and trucklike vehicles which ride on large air bags. Each has unique advantages for traveling in such problem areas as marshy, wet, or boggy terrain, deep powderlike snow, or permafrost overlain with a thin, protective tundra layer.

Vehicles such as these typically are used only when a limited amount of travel along a route is needed. When a greater amount of traffic is anticipated along a route, it may become necessary to construct a temporary road. In the Prudhoe Bay area this is done only in the winter, when

ice roads are built over which conventional trucks and equipment can travel.

A hovercraft was used in 1969-70 for a variety of test functions, including hauling drill pipe from Prudhoe Bay to Nora Federal No. 1 and supporting a seismic crew on the ice in Prudhoe Bay. These tests showed that while air-cushion vehicles can be used for transportation on the North Slope, there are certainly definite limitations to their useful operation.

In 1970-71 a vehicle called "Twister" was brought to Prudhoe Bay by Lockheed. This was a prototype vehicle, which can be described briefly as an eight-wheel-drive, articulated super dune buggy. It, too, had use limitations. A larger version of Twister is now marketed, however.

In the summers of 1971, 1972, and 1973, a Tundra Cleanup Program was funded and operated by the oil industry. In 1971 two "Albee" rolligons were used for this program, and in 1972 and 1973 two Bechtel RD 85 rolligons were used. Purpose of the program was twofold: first, to remove some of the litter left by previous seismic activity; second, to test the effect of summer travel on the tundra. Annual observations show that tracks made during the cleanup program have largely disappeared.

Today's winter road construction technique consists of filling low spots in the tundra with snow and spraying water on it to make a smooth driving surface. Motor graders and steel drags are used to pull snow onto the intended road surface, where multiple passes with steel drags and water trucks help make a frozen road surface that is surprisingly smooth. An important advantage with this technique is that no berms are built on the road edges; therefore, blowing snow does not create drifting problems.

With continued cooperation between permitting agencies and public domain users, we can continue to convert natural resources to products essential to our American way of life, enjoy our personal recreational preferences, and leave some resources for future generations.

Problems and Nonproblems of Surface Disturbance in Mineral Prospecting

C. C. Hawley

ABSTRACT
Several techniques of modern mineral exploration are carried out almost entirely without adverse surface impact, and perhaps only need to be pointed out for the record. Most preliminary exploration in Alaska is supported by helicopter, fixed-wing aircraft, and boats, operated either from completely portable fly camps or from lodges. The techniques of preliminary exploration--geologic mapping, geochemistry, and electrical geophysics--involve, at most, disturbance of the surface by shovel or hand auger.

Secondary exploration activities cause slight damage, which can often be alleviated by good logistics. In summertime, drills and equipment are most often airlifted to the prospect site, and in winter, use of both cats and Nodwell-type vehicles allows movement of equipment, camps, and crews with minimum surface disturbance.

What then are the problem areas? One is the necessity of using heavy equipment in secondary prospecting and development, and related to it, the process of moving the equipment to the prospecting site. Other problems, such as removal of overburden, are characteristic of placer mining. In part this problem is real, but in many small streams damage is inconsequential, and in others, removal of muck--by whatever means--can be beneficial to the environment.

Recognizing that mining is a surface-disturbing industry, it is possible that many problems of surface misuse could be alleviated by research, education, and enforcement of mining laws.

Specific examples of possible solutions to problems are the use of backhoes and powder rather than bulldozers for trenching, wintertime excavation of placer overburden, and possible extension of the prudent man concept to mine access.

In general I don't believe that my assigned topic--surface damage in prospecting--is a large problem, but it does have problem areas that are worthy of discussion.

It is often difficult to get to gut issues in a conference like this, but we might as well try to get to real problems like economy vs. ecology, the role of the BLM, revision of the mining law, and miners running amuck with cats on d-2 lands.

In general, I will suggest that some surface damage problems can be lessened by a combination of things, including education, modification and enforcement of laws, and research. But at the same time I will try to convince you that you are going to have to face surface damage on a few square miles in Alaska.

To set the stage for discussion of both problems and nonproblems, we can review the process that is involved in finding and developing a mine, at the same time examining surface impacts in various stages of this process and possible remedies. Each of the major stages can be divided to examine areas of surface disturbance.

Exploration--as used here--is the search for indications of significant mineralization. In current practice in Alaska, it involves geochemical sampling or panning, reconnaissance mapping, and sometimes airborne geophysics. Most of the work is done without equipment other than a geologist's pick, and access is usually by aircraft and foot. There is almost no surface damage.

If significant indications of mineralization are found, a decision may be reached to stake claims. Staking is not particularly surface damaging, but brushing and clearing lines have been overdone in some instances, leaving temporary unsightly cuts. In most major staking programs, brushing requirements are not met strictly. Most staking is done by end line system which sets all corners up without brushing side lines, and lines are run tight.

In many cases, the lines are used in the mapping or evaluation process, but in most cases, a larger claim size tied to a protraction system would be more efficient. For those of you familiar with the language of both federal and state mining law, notice some short cuts. Most important is really that a prediscovery system is being used. Claims are staked on

AREA USED	STAGE	SURFACE DAMAGE (access)	REMEDY
Geometrical decrease	EXPLORATION	VERY MINOR (Mainly airborne)	MINING LAW
	PROSPECTING Equipment use and surface damage increase throughout this period.	MINOR TO MODERATE (Air and ground)	MINING LAW EDUCATION RESEARCH
	DEVELOPMENT	MODERATE TO SEVERE (Air and ground)	EDUCATION RESEARCH

Surface damage at three stages of mining development and some remedies.

the basis of general evidence of mineralization, rather than a discovery per claim.

Prospecting follows. During this stage an attempt is made to validate the claims by making discoveries. The process involves detailed geologic mapping, geochemistry, and electrical geophysics with hand tools. Generally, some surface is disturbed, with cuts or trenches and shallow drill holes.

Although new mineralization may be found during the process and further land acquired, the actual area used may shrink. Surface disturbance is minimized by dominant air access, use of self-contained small pneumatic drills, like the Cobra. Experience has shown that in ground with little overburden, trenches with smaller surface area can be made by blasting or backhoe rather than by cat, and blasted trenches need no machine access but do require more hand work.

Alaska law has no claim validation requirement, so the practice found in other states of making random cuts on all claims and calling them discovery cuts does not take place. In general, it is not a problem here.

Minor modifications in law specifying that geophysics or drill holes could be used for discovery might stop some surface damage--as would better education into the use of trenching powder.

In the prospecting stage, most access can still be by air, and if cats are necessary, damage can be alleviated by using winter access or following ridge tops. Here education and diplomacy can produce positive results.

If these preliminary and general minor damaging studies are successful, the stage is set for more advanced prospecting with larger drills, bulldozers, and underground excavation.

There are cases where enforcement of mining law, or at least the possibility of enforcement, can prevent needless surface damage, yet not hinder a serious prospector. An example might be in so-called discovery cuts which are really not put in to find minerals, but as window dressing. The BLM has made the point, and doubtless with good reason, that litigation is extremely expensive, but the examination of prospects on a regular basis by BLM examiners, with the possibility of enforcement in the background, should be sufficient in many cases to improve exploration practice.

It is possible to transport the largest diamond drills being used in Alaska to the drill sites with helicopters, but at about this stage, heavy equipment helps, and prospect roads are commonly made. With few exceptions, these are limited to the best of the claim areas. Semipermanent camps are a minor surface use here.

Forest Service regulations call for a prospecting plan to be made and approved before work can proceed. This requires bonding and may prove detrimental to the small operator. Industry has had little experience with these regulations, but in general they do not seem to interfere with the serious prospector although in most forest areas, examples of what appear to be arbitrary interpretations and exclusions have been reported from highly scenic areas.

If the results of this stage are favorable, the next stage will be the attempt to develop the mine. Except for placer mining in Alaska, this stage has not been reached for a large mine since the early 1900's.

From placer mining, surface damage will occur. Some could be alleviated by research, and many placered lands are fairly easily reclaimed, either at the time of operation or at a future point when economics make the land valuable for other purposes. Although some people think that dredge tailings are unsightly, those in the Fairbanks area are now generally free from permafrost and can be used for many purposes.

A major problem that does need research is removal of frozen muck or overburden. Because of its extremely fine grain size, the material is almost impossible to dewater if thawed or to get settling in a reasonable distance.

At least two miners have had success with blasting and cat removal of ice-rich permafrost. The material is drilled with rotary holes on a pattern and blasted toward a free face. The ice material can then be dozed behind temporary dams. Perhaps ripping and blast breaking of other types of frozen overburden could be carried out in winter with heavy equipment. Then the material could be transported by truck to sites where it would not enter drainage systems when thawed. The system would use more equipment and is several times more expensive than hydraulicking, but perhaps could be economic in very large operations.

It should also be pointed out that in many creeks, conventional hydraulicking still can be used without appreciable damage. Recent experience in the Yukon Territory, where placer mining is regulated, shows that check dams used in narrow stream valleys are counter productive, and at best only temporarily impound materials. In these cases, it appears that flushing silt down at a rate that can be handled by the larger streams is actually the best practice, even though it does produce temporary downstream siltation.

While we are on placer mining, we might as well talk about Kantishna. One of the main road-building flaps is there--terrible land destruction in a sacred d-2 area. But that is not what's terrible. The fact is that Kantishna is a mining district and could be an important one. The problem is in putting it in d-2 land in the first place. In my work for the U. S. Geological Survey, I learned just what National Park Service attitudes on minerals are. Rather than excluding mineral areas from parks or monuments,

the policy has been and is to include them so they can't be exploited. This same policy has been followed on d-2 lands in Alaska.

Mount McKinley National Park includes one mineral belt which essentially bisects the park; it is flanked on the north and south, respectively, by the Stampede-Kantishna and Chulitna-Yentna mineral belts. Like all mineral belts, these are not uniformly mineralized, and it is possible to select areas with outstanding scenery or wildlife values which could be added without including minerals, but that has not been the policy.

I believe the National Park Service policy at least potentially causes increased surface damage by its effects on who mines there. The restrictiveness of National Park Service policies has essentially limited activities to previous owners of ground and to inexperienced operators who believe that their rights to mine actually mean something. Larger mining companies with expertise and capital for land protection know that there are no important mines in those National Park areas supposedly open, so they generally avoid them like the plague. Perhaps I am maligning the parties who built the Kantishna road, but it is very likely that they were not very experienced--either at mining or at road building.

There are other road problems. Here is one suggestion. If roads are a real problem, why not try to extend "the prudent man" doctrine to access? This concept has been one of the main bases of validity of mining claims. Discoveries have been held valid if they were sufficiently good that a "prudent man" would expend efforts to further develop them into paying mines. It used to be common practice in the lower 48 for speculative mining companies to build a mill before trying to prove ore reserves; in almost all cases I have seen, the mine failed for lack of reserves--surely an indication that a prudent man was not around when the plans were made. Does a prudent man build a 50-mile road before going to the considerable expense to prove reserves?

The typical attitude of BLM is that it does not have the manpower to tackle all the violations, but it should have the manpower to try for significant decisions which can be publicized.

I would like to go back to the outline. Although Alaska hard rock properties have not really gotten to the mining stage, some are close. We will accept the facts that actual large-scale mining does major damage to surface and that quite a bit of damage can be alleviated and land reclaimed. But much damage cannot be totally eliminated. A partial solution is to reemphasize underground mining, but this demands much more research in order to regain economic feasibility, and it cannot be a total solution because it will not apply to many large low grade deposits lying near the surface. A major problem is ignorance--first, ignorance of the populace of how little land mining actually disturbs; second, lack of knowledge of the dependence of our economy on mineral products.

First some figures on land use. On a country-wide scale, all mineral extraction activities, including oil and gas, sand and gravel, and all nonmetallic, metallic minerals, use about 0.2 percent of the surface at any one time. In two so-called mining states, for comparison, metal mining uses 1/7 of 1 percent of Arizona land, and in Idaho phosphate and metal mining together use less than .01 percent of the land's surface. The fact is that mineral resources are extremely concentrated, and surface disturbance, though major, is not important areally.

If we use country-wide statistics in Alaska, we could assume that at any one time about 750 thousand acres out of 375 million acres would be used. Actually, since most of the U. S. figure is based on urban area use of sand-gravel and other construction material, the true figure would be more like 75 thousand acres, or 0.02 percent of all Alaskan land. Almost certainly the land used for mining purposes over the next hundred years in Alaska will be much less than land now disturbed in the immediate Anchorage area.

If there is a problem, it is mainly in the eye of the beholder. In terms of land use, mining is nothing. Agriculture uses over 50 percent, commercial forests about 25 to 30 percent, urban impacted land some 12 percent. Parks and refuges use at least 5 percent. Where is mining?

Our standard of living depends on production of about 40 thousand pounds of mineral products per year per individual. Even if you are willing to cut back on your standard of living by 50 percent, population is still climbing drastically, and extreme and rapid tinkering with the standard of living just isn't going to be tolerated by the electorate. We've seen just how much people are willing to cut back on energy without coercion, so imposed cuts on the standard of living may only serve to hasten the day when an impoverished populace demands dictatorial rather than democratic solutions.

Two laws are pertinent to today's discussion: one is the federal mining law; the second is a BLM Organic Act. The Mining Law of 1872 is widely denounced as an antique law not suitable for today's reality. How could a law more than 100 years old be adequate in 1976?

First of all, a law--any law--is not just the initial statute. It is this, plus all the case law which has been applied, plus the regulations, plus enforcement or lack of it. So, in reality, the law has been updated by evolution over 100 years. As currently enforced, it allows pre-discovery rights: it assumes vertical boundaries rather than apex. Although most miners do not assume property rights without mining potential, the law has not changed enough to suit its critics in its emphasis on the freedom of the individual, both in what he does on his claims and how he gets there and transports ore. Evidently, there are many here who believe that surface damage is more important than individual freedom. I would join in denouncing irresponsible and ignorant individuals who needlessly damage the surface, but I would prefer some

damage to the complete loss of individual freedom which is contemplated in most proposed revisions of the mining law.

The Northwest Mining Association has made a series of recommendations, which preserve the spirit of the 1872 act, but correct some of its deficiencies. These suggestions include the following:

"CLEAR the title of public domain lands of long-dormant and abandoned claims.

"RECOGNIZE the validity of the right of secure title to the minerals based upon the fact that a mineral explorer is prepared to expend substantial effort and funds in exploration and development of a mineral property.

"PROVIDE for the Act of Location of a mineral claim to be performed in an appropriate Federal Land Office.

"REQUIRE the conformance of claim locations to the legal subdivisions of Public Land Surveys.

"ELIMINATE the distinction between lode and placer claims.

"PROVIDE for flexibility in the size of claims and increase the maximum size of claims to meet the requirements of modern exploration and mining methods.

"MAINTAIN extra-lateral rights on existing claims.

"CONFINE mineral rights to within the vertical boundaries of claims located in the future.

"ALLOW for offsetting credits for excess annual assessment work expenditures to be applied to succeeding years.

"PROVIDE for optional payments in lieu of work performance for a limited number of years.

"REQUIRE that the burden of proof for the performance of assessment work be that of the mine claimant.

"AVOID adding redundant provisions within the mining law pertaining to laws and regulations already applicable to the mining industry.

"TAKE into consideration the economic aspects of maximizing the recovery and utilization of mineral resources.

"PROTECT the opportunity of the individual and small miner to competitively participate in the future of the mineral industry.

"SUPPORT the continued role of private enterprise in national mineral resource developments."

Most industries today find themselves in the position of being damned if they do or if they don't. If revisions are reasonable, they will be supported; if not, they can only be opposed.

The same problem exists in the BLM Organic Act. One version of a BLM Organic Act eliminated the Mining Law of 1872 and substituted a competitive leasing provision within the Organic Act. Even though most of us would agree that BLM should control surface use, we cannot support this legislation.

In the last few years, all of us have learned about ecology, and the principle that environment and life are interrelated; we have learned that ecosystems are a natural entity. Now I believe that it is time to remind some of another word which uses the same Greek root--oikos. The word is economy, and in this sense "THE ECONOMY," which could be defined as the economic structure of a country. Just as changes in environment lead to changes in life, changes in any segment of the economy affect the body as a whole.

People in high-risk industries or polluting industries like mining estimate that the sum of all the new laws like NEPA, OSHA has increased the cost of doing business by well over 50 percent. Further, it has cut their productivity significantly and added to an already overloaded bureaucracy. This escalation of costs just cannot continue without the death of our economic system.

I believe the evidence of the last few years is that industry will consider environment--now may we have the return compliment from you?

Military Maneuvers and Surface Disturbance

LTC Dennis L. Engen

ABSTRACT
The U. S. Army attempts in many ways to reduce surface damage during maneuvers. Wheeled vehicles are confined as much as possible to roads. Soldiers are trained to travel long distances on foot in summer and on skis and snowshoes in winter. They also are instructed in ways to avoid damaging the environment. Helicopter use helps reduce surface damage; weapon emplacements and fighting positions are built up from the ground rather than dug in. Waste is hauled out instead of dumped. During military exercises, operations are confined within designated areas, and airfields are named neutral zones to serve as common refueling points and confine oil spills. Considerable effort is made to coordinate with federal, state, and local governments, Native corporations, and individuals for land use. On some exercises, the Army has been able to improve areas by removing trash.

On behalf of the 172d Brigade, I want to thank you for the chance to tell you about some of the things we are doing to lessen the effects of military maneuvers on our environment in Alaska.

Many of you have been in the Army, and you know that the practice of marking off the maneuver area by painting rocks is a very traumatic thing to some people. I've painted my share of rocks in my day and realize it is a sore point for the dedicated natural rock fancier. Just to

set your minds at ease, we've quit painting rocks and outlining our area when we go into the field. I've noticed, though, driving down Turnagain Arm, that such sentiments as "John loves Mary" and "Class of '74" are painted on the rocks, but I think that eventually, those too will be corrected.

Seriously, the Army has made great strides in minimizing maneuver damage. Like everyone else, we've got a long way to go but I think we've made some significant progress.

When we think of military maneuvers, most of us visualize tanks and armored personnel carriers knocking down trees and generally tearing up the countryside. As shown on this slide[1] we don't have tanks or armored personnel carriers. This has not always been true. In the past both tanks and armored carriers were used in the active Army. Now, our use of wheeled vehicles is limited as much as possible to the existing road network.

As you probably know from reading the newspapers, strong emphasis is being placed on the physical conditioning of our soldiers. We aim primarily toward developing soldiers to a standard so they can cover long distances on foot in summer and on skis and snowshoes in winter. A significant benefit is that we minimize the effect on the terrain when we move by foot.

This slide shows the means by which we move troops in Alaska. Helicopters are extensively used for a wide variety of operations, such as combat assaults, reconnaissance, resupply, moving of artillery, and command and control. Fortunately, they have little effect on the terrain. I think probably the most obnoxious and most irritating problem with helicopters, especially Hueys, is that they make so much noise.

Using helicopters saves us from damaging the terrain when we move artillery into place. In addition, we sandbag the weapons to keep from having to dig them in. As any of you old artillery men know, if we dug in these artillery pieces as we should, we would tear up a lot of real estate. Instead, we use sandbags and keep from cutting up the ground.

When infantry troops move into an area, their fighting positions are built from the ground up. Tactically, this is not too good a practice; however, it does eliminate the need for us to dig a lot of holes in the hills all around Alaska.

Cutting trees or any other vegetation is prohibited. The soldiers can use deadfall as long as they dismantle the position before moving out of the area.

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[1]Because of printing limitations, color slides used by LTC Engen in his seminar presentation are not reproduced here.

While occupying field positions, we take elaborate precautions to protect the terrain. As you see on this slide, garbage, which attracts a lot of animals, is disposed of by hauling it out in plastic bags in summertime. In winter, we use double-lined heavy paper sacks. Ordinarily, dishwater and cooking water aren't much of a problem, but when you're cooking and washing dishes for 200 troops, water disposal can be a significant problem. We used to dump the waste water on the rocks or into streams, but this attracts just as many wild animals and disturbs game just as much as if we left garbage lying on the ground. Now, we backhaul the dishwater and cooking water as well as the garbage. When you have a large number of troops in the field, this helps significantly to reduce disturbance of the local environment.

On the next slide, we show the Jack Frost exercise presently under way. As you see, the area from Galena all the way to Big Delta is roughly 400 miles. To cut down on problems in the vicinity of Galena, Tanana, and Nenana, we have confined objectives for the troops to a 10-mile radius around these locations. Within these 10-mile radii is a lot of land that we are not at liberty to use, so we are not really taking a big swath all the way from Galena to Big Delta, but are limiting activities to the land within these circles and to other areas that we have permission to use.

Another step we've taken in the Jack Frost exercise is to designate the primary airfields as neutral zones. This enables us to have a common refueling point for the good guys and the bad guys. We don't end up with two refueling points in one area where we're likely to have oil spills or other fuel spills.

A lot of legwork is needed in coordinating with the federal, state, and city governments, the Native corporations, and individuals for use of land during military exercises. We have been most appreciative of the assistance we have had from the civilian community in getting maneuver permits for this exercise.

To provide guidance for our soldiers, we have put out little information booklets. Here are some guidelines from these booklets:

- Avoid aerial harassment of game.

- Avoid moose yarding areas, caribou herds, and beaver houses.

- Avoid traveling in clear-water streambeds.

- Avoid use of pyrotechnics.

- Don't cut live trees.

The 172d Infantry Brigade makes every effort not only to prevent damage to the land but to improve it and leave it in better condition

than it was when we entered it.

As an example, last summer our artillery battalion hiked the Resurrection Trail. This provided an excellent opportunity to police up trash and garbage that had been left along the trail. The amount that they cleaned up there was significant.

During the 1974-75 period, we had a mission to provide a high-altitude rescue team for emergency and contingency plans on Mount McKinley. I think it's significant that we removed more than 2,000 pounds of trash during that exercise on the side of the mountain. I think we made it a better place.

The last slide shows the Eklutna area. Some of you know we train in the Eklutna Glacier area where we have a little land. In return for the many favors that we've gotten from the Park Service and other civilian organizations, we maintain the seven miles of road leading back toward the glacier. I'm sure that many of you have driven that road. In October, we sent 200 troops out and policed around the entire shore of Eklutna Lake.

In summary, we of the 172d Brigade want to do all we can to improve our methods of protecting the environment by educating our soldiers and placing emphasis on elimination of damage from maneuvers. Our stake in this is extremely high since we must have continued access to these lands if we are to train our soldiers adequately for defense of our land. One way we feel that access can be assured is by being good neighbors and making every effort to protect the beauty of the land and to make it a better place for all.

Transportation during Exploration of Naval Petroleum Reserve No. 4

John F. Schindler

ABSTRACT
During early development of PET 4, tractors proved to be the most effective freight movers. They were the principal hauling elements of the winter cat trains. It was found that as much hauling as possible should be done over the ice of the ocean, lagoons, and lakes, or parallel to streams. Cross-drainage hauling was infinitely more difficult because of the rough terrain and the hazards of the low-cut banks of rivers and streams that would stop or delay the tractors and sleds.

The logistics of transportation of workers, supplies, and equipment was the major problem, and its solutions the most valuable lesson learned in the early exploration of PET 4.

The history of Petroleum Reserve No. Four (PET 4) is really a description of a learning process--the gaining of experience and knowledge of arctic operations by the United States military and subsequently by United States industry. Prior to this effort, there had been little movement of heavy equipment and supplies overland for any distance in the Arctic. Previous travel had always been by dog team and sled, and the loads carried were, consequently, light. Any heavy loads were not moved far from the coast or the rivers, as water transport in the brief summer was the only feasible method.

The first white man to see a portion of the Reserve was Capt. James

Cook in 1778, but he barely set foot ashore. The surveys of Capt. F. W. Beechey, Master Thomas Nelson, Mate William Smyth, and Sir John Franklin, all of the Royal Navy, as well as Peter W. Dease and Thomas Simpson, Hudson's Bay Company officers, in the 1820's and 1830's also were essentially sea borne. The first "overland" or inland trip was made by Ens. (later Rear Adm.) William L. Howard in 1886. He traveled from the Noatak area to the valley of the Colville, then to the Chipp River by sled and dog team in April and May. The trip to Barrow was completed by skin boat. Almost all subsequent surveys, including those of the geologic parties in the early days of exploration, were done this same way--by dog team and/or by riverboat. This was the status of knowledge of arctic transportation in the winter of 1943-44 when plans to explore the Reserve were being made.

We must also remember that the United States was engaged in World War II and patriotic fervor was at a peak. Every avenue for victory was to be explored and exploited. On February 5, 1944, the Director of Naval Petroleum Reserve (Rear Adm. Stuart) initiated action with a memo to the Secretary of the Navy proposing further exploration of PET 4.

The bureaucracy worked admirably and efficiently in those days. Within 40 days after the first memo was sent, the Secretaries of Navy and the Interior, the Attorney General, the War Department, and the Naval Affairs Committees of the House and Senate all agreed and authorized the program. Preliminary reconnaissance was undertaken on March 21, 1944, and further action was to be based on that first report.

The first reconnaissance was by bush aircraft and was quite limited. Inclement weather kept the airplane in Barrow a good deal of the time so the recommendations of Charles D. Brower played an important role in the report. (Brower was a whaler and trader for the Cape Smyth Whaling and Trading Co., lived in Point Barrow for 61 years, and often was called King of the North.) The report was made a month later, and although there was a brief period of uncertainty, decisions were made rather quickly and procurement began. I am reiterating the schedule in this talk to emphasize how little time there was to plan and consider the logistics problems to be faced in an entirely new area. This short time for procurement and the subsequent "full speed ahead" philosophy had a strong influence on the attitude of the expedition party.

The original cargo estimate was 5,000 tons, but it actually totaled 13,338 tons plus 196 Seabees and 235 stevedores. The first BAREX (later called Barrow Expeditions) left Tacoma on July 20, rounded Point Barrow on August 5, and reached Cape Simpson on August 6, 1944. For four days the crew searched for a suitable landing beach and campsite near the oil seeps, but finally gave up and returned to Barrow, the second choice for a camp.

On August 12 the unloading began, and in spite of storms and high

winds was just about completed by August 30. It is interesting to note that on August 30 one ship commander, thinking a hurried departure was necessary because of closing ice, ordered the stevedore units back to the ship. One unit of 66 officers and men didn't make it and was left stranded. Fortunately, a civilian ship, the SS Waipio of the Matson Co., came north at Governor Gruening's urging to deliver supplies to the Native village. The stevedore unit assisted in its unloading and returned south aboard that ship. Again, this demonstrates the attitude of the personnel of the expedition and their lack of knowledge and subsequent uneasiness about the North.

The crews moved materials, equipment, and supplies, and built the primitive camp that first summer, all, in essence, without leaving the confines of the gravel beach. It is also interesting to note that one of their first efforts was to assemble a drill rig and try to drill a water well, again demonstrating lack of knowledge.

In September, work was started on a permanent airstrip north of the camp. Tundra was used as a binding agent on the sand and gravel for the strip that paralleled the beach. A cross strip was constructed by leaving tundra intact and filling in the area between the hummocks. Fortunately, no early landing planes broke through the crust of either strip and after freezeup, both served remarkably well. By the end of 1944, the PET 4 camp was well established and exploration was ready to proceed.

The 1945 season strongly set the pattern for logistics within the Reserve for the Navy as well as later for industry. By late 1944, it had become apparent that one of the major tasks of PET 4 was to find some means of freighting large tonnages many miles over the Reserve.

The tundra presented almost insurmountable difficulties to such operations in the summer. The profusion of lakes and streams made heavy hauling extremely difficult, but the surface thawing of the frozen ground posed the greatest problem. The crews soon learned that the tundra becomes an untraversable quagmire if torn up by heavy motorized equipment. Some trips were made in summer, especially by seismic crews, and the method employed was devastating to the tundra. The lead tractor would drop its blade and clear the thawed layer to the permafrost level. The sleds would then travel on this base.

It was apparent by the beginning of 1945 that most heavy hauling would have to be done in the winter. Preparations were begun, and wanigans for living quarters were mounted on bobsleds. Pipe sleds, called Panecheks for the man who designed and built them, were made to supplement the commercially designed Michler bobsled. A Panchek is a very heavy-duty sled, with runners made of 6- to 8-inch drill pipe and a bed of heavy timber held in an angle-iron frame. Athey wagons, a trailer arrangement on tracks and bogies, were also employed.

The first sled trip was to Cape Simpson, 75 miles from Barrow, and

the tractor train started on January 22, 1945. It was quickly learned that there were great advantages to freighting as much as possible over ice rather than tundra. Travel was very bumpy because of the rough surface of the tundra, snow drifts, and the banks that had to be negotiated at stream crossings. The sleds frequently burrowed deeply into snow banks. As a first trial, two tractors (D-8's) were used to pull five sleds each. This was found to be insufficient power, so the first expedition was made using three tractors pulling a total of eight sleds, four of which carried payloads. The other four were eating, sleeping, and servicing wanigans.

The last half of the trip to Cape Simpson was over sea ice and was so successful that the entire return trip was made over sea ice. Ice travel was much smoother and easier hauling, although some difficulties were encountered at thinly covered leads. With care in the nearshore and lagoon areas, however, these leads could usually be circumvented.

The Weasel (M29C) proved to be a useful vehicle for scouting ahead. The performance of the tractors was excellent, as was that of the welded pipe sleds and the Michler sleds. The Athey wagons had a great deal of down time. Unfortunately for later generations, the first experience showed that much rough travel and equipment wear and tear could be eliminated if a bulldozer blade was attached to the lead tractor. So trail

Fig. 1. Cat train led by D-8 Caterpillar tractor with snow plow pulling a wanigan on a Michler sleigh. Operator is clearing down to tundra. Tractor tracks will leave marks but less severe marks than when the top layer of tundra is removed. (J. F. Schindler photo)

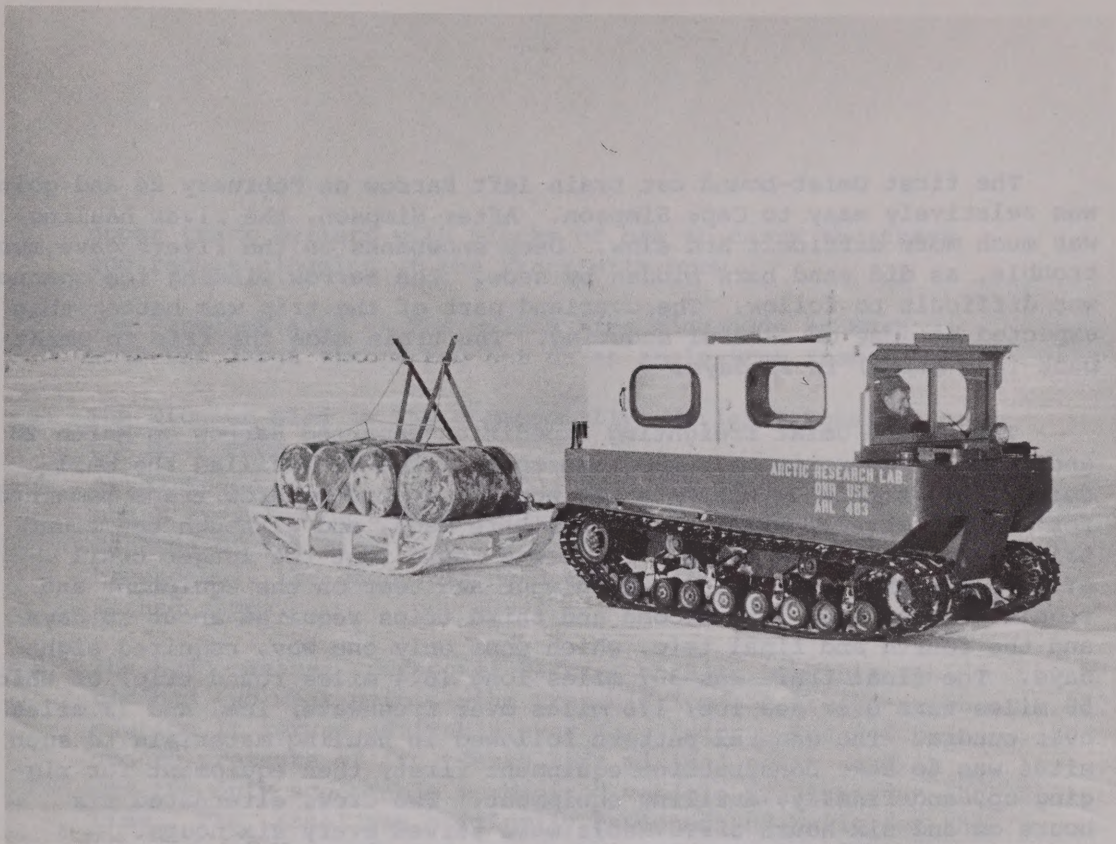

Fig. 2. The M29C Weasel personnel carrier pulling a light load. This was the only lightweight mechanized vehicle available at the time of exploration for over-tundra/snow personnel transportation. (J. F. Schindler photo)

blazing often included knocking down hummock tops and other obstructions. Fortunately, this was tough work and avoided as much as possible.

The first trip from Barrow to Cape Simpson and back took four and a half days. On the second trip, the lead tractor (with the blade) hauled only wanigans and followed the track of the first trip. As a result, heavier loads could be hauled and the round trip was reduced to two and a half days.

After this shakedown effort, the first long haul to Umiat was made. This trip was important because everyone felt that unless it was successful, the exploration program would not be feasible.

The route of the first Umiat freighting trip was Barrow to Cape Simpson, up the Chipp River to the Ikpikpuk, up the east fork of the Ikpikpuk to its head, and then 65 miles overland to Umiat. The last leg was scouted by dog team because the scouts found the Weasel did not stand up well to the rough terrain.

The first Umiat-bound cat train left Barrow on February 24 and going was relatively easy to Cape Simpson. After Simpson, the river hauling was much more difficult and slow. Deep snowbanks on the rivers gave much trouble, as did sand bars hidden by snow. The narrow winding ice channel was difficult to follow. The overland part of the trip was better than expected because of careful scouting. The train made the trip to Umiat and back (635 miles) in 22 days.

The second Umiat freighting expedition departed Barrow on March 28 and followed approximately the same route. The wind filled the bull-dozed trail with snow within a few hours, but the windrow trace remained for weeks. Several overland cutoffs were made, and although the round trip was shortened to 586 miles, it was found that the longer trail over as much ice as possible saved wear and tear on the equipment and required less time. The second and third trips required about 18 days and the fourth and final trip, which went only one way, required eight days. The final trail was 307 miles long (614 miles round trip) of which 58 miles were over sea ice, 176 miles over freshwater ice, and 73 miles over tundra. The general pattern followed in hauling materials to such sites was to take construction equipment first, then equipment for rig-ging up, and finally, drilling equipment. Two crews alternated six hours on and six hours off. Meals were served every six hours.

During the summer of 1945 both of the nation's major World War II enemies were defeated, and an item of high priority became the discharge of men eligible for release. It became apparent that continuation of PET 4 would be possible only by converting the exploration program to a civilian contractor operation. A letter of intent was written December 17, 1945, which allowed a consortium called Arctic Contractors to set up its organization to continue the job.

A great amount of winter freighting was done in the years through 1952 but with little change in method. The operation was closed in 1953. The major difference between the Seabee operation and that of the civil-ian contractors was the choosing of a new route to Umiat. Justified on the experience that sea ice hauling was easiest, a route was chosen from Barrow via the Arctic Ocean to Teshekpuk Lake, across the lake to the mouth of the Colville River, and up the Colville to Umiat. The scouting was done by an Eskimo guide and two men in a weasel. Another innovation forced by the increased program and a lack of equipment was the use of trucks for the haul to Simpson. This was reasonably successful although the maintenance cost was high. Tractor haul was still the preferred method.

Overland freighting in the early days of PET 4 was done with the following equipment.

1. Tractor type -- The D-8 Caterpillar, often with cleats, cut into the tracks to keep the equipment from slipping down inclines. Another modification was the replacement of the

upper track rollers with blocks of oak to carry the track and reduce clogging of the track with snow.

2. The Panechek sled -- The welded pipe sled made at Barrow with the large timber bed set on an angle-iron frame.

3. The Michler sled -- The commercially available bobsled, good for deep snow conditions.

4. Athey wagon -- The commercially available trailer wagon which traveled on a short track and bogie arrangement. Because of the high cost of track maintenance and frequent breakdowns, the wagon was used mostly in and around established camps.

5. The M29C Weasel personnel carrier -- Although this vehicle had two weak points--the transmission and tracks--with caution it served admirably over long trips. The 1.8 psi ground pressure of its tracks left minimal scars, and it was the only acceptable mechanized vehicle available at the time. The easel was originally designed and built for the invasion of Normandy and was to be used only for the initial push inland of about 100 miles. The original vehicles had no provision for oil change.

6. Where roadbeds that could support trucks and jeeps were maintained, wheeled vehicles had important use--limited mainly to established camps such as Barrow and Umiat.

session three

CHAIRMAN: Richard H. LeDosquet, District Manager
Bureau of Land Management
Fairbanks District Office
Fairbanks, Alaska

SURFACE DISTURBANCE--continued

Effects of Industrial Development on Surface--Access to and for developments

Access and Effects of Oil and Gas Development on Kenai National Moose Range Lands

Robert A. Richey

ABSTRACT
Development of an oil and gas industrial complex on the Kenai National Moose Range has affected the surface of many hundreds of acres of land. This discussion points out the extent of this disturbance, compares it to exploration disturbance, and explains methods used to keep the disturbance to a minimum. As a result of industrial activities, spinoff disturbance occurs and is also discussed.

I am delighted to have the opportunity to discuss with you some of the activities with which we are familiar on the Kenai. I shall limit my talk to oil and gas development on the Kenai Refuge. Refuge Manager Jim Monnie has asked me to focus my discussion on surface disturbance of these Refuge lands. We must acknowledge that a good deal of disturbance can accompany the extraction of oil and gas resources on most lands. I will discuss some of the methods we use to minimize these disturbances on the Kenai.

The Kenai National Moose Range was established in 1941 to preserve in the national interest a distinct ecological and representative unit of outstanding habitat for the prominent species--moose. This interest extends to all the indigenous species on these lands. The Moose Range 1.7 million acres were dedicated and withdrawn as a National Wildlife Refuge, one of 18 in the State of Alaska and one of approximately 375 refuges established throughout the Nation.

On these dedicated lands, we have been mandated to authorize the development and exploration of gas and oil. The initial establishing order of 1941 closed to entry all mining, except for valid and existing mining claims; it did not, however, prohibit mineral extraction.

A major Refuge responsibility includes the protection of wildlife/wildlands habitat. Before oil and gas leasing of these lands could take place, the lands had to be classified in cooperation between the U. S. Fish and Wildlife Service and the Bureau of Land Management. This classification resulted in the designation of those lands that would not be subject to oil and gas leasing. The submitted classification plan was approved by the Secretary of the Interior on July 24, 1958, opening about one-half of the Refuge lands to oil and gas leasing. That half not open--primarily the foothills and mountainous areas--was set aside to protect major physical resources such as prime moose habitat, scenic areas, and natural areas that had not been involved in recent fires.

In reviewing the Kenai records, we find that in the early 1950's a great deal of interest generated on the probability of considerable gas and oil resources within the Refuge. It was not until July 31, 1956, that a unit plan for the development of these resources was approved. In late 1956 a major road into the Swanson River Oilfield was constructed to the first drilling site--at the extreme north end of the field. Oil was discovered shortly thereafter at "Discovery Well," on July 23, 1957. By 1960, drilling pads and associated surface disturbances covered about 10 to 12 square miles and 45 crude producing wells had been completed.

To develop this field, industry had to get to it. The initial take-off available to developers was the Sterling Highway at a point about 11 miles east of Soldotna. From the highway, they constructed a very fine gravel road about 20 miles in an almost straight northerly direction. The right-of-way followed the natural contours of the land and is still very well maintained. During road construction as well as during construction of the oilfield and pad facilities, Refuge regulations required that topsoil and forest debris be saved for future rehabilitation along the right-of-way or in other disturbed areas.

Associated with the development of the Swanson River Field was an ongoing geophysical program of oil-related seismic activities. These continue today. Two programs are proposed for this winter, and we hope we will have sufficient snow cover so they can be conducted.

Before seismic operation could begin, however, certain general stipulations were developed to protect the land resources. In addition, special conditions were drafted by the Refuge manager to further protect these specific lands. Because of these stipulations and regulations, found mainly in Titles 43 and 50 of the Code of Federal Regulations, we had a unique opportunity to protect Moose Range lands. We really had laws with teeth in them, in contrast to a situation described yesterday in which vast amounts of land today are protected only by guidelines. That can

truly be a hardship on the land-managing agency.

In the process of administering these regulations and conditions, we learned a great deal. None of the Refuge staff had training related to oil and gas development and we had a lot of learning to do.

The initial seismic effort in the 1950's required the use of dozer equipment to cut lines through mature timber stands of spruce, aspen, and birch. Today, 2,500 to 3,000 miles of seismic trails crisscross the northern half of the Refuge. Regulations required that the lines be constructed in a right-of-way not more than 15 feet wide during proper winter conditions; that is, when there was sufficient snow and ice cover to protect the underlying vegetation and terrain. Stipulations were designed to prevent the scarring of the surface and possible future erosion problems.

By 1967, there were so many miles of seismic lines on the Kenai and the technology for recording geophysical information was so advanced that it was not necessary to construct additional lines. Since then, we have not permitted the use of dozer equipment for new line construction and the industry has been authorized to use existing lines only.

We are also concerned with proper cleanup following the seismic program and prevention of stream blockage. Most recently, industry has used Vibroseis[1] and Vibrotrack equipment on the Refuge and we have been well satisfied with these Vibroseis operations. That is not to say that drilling and use of explosives are not as effective for obtaining necessary information, but we have observed that the Vibroseis operation is a cleaner and less resource-disturbing operation.

Developing an oilfield requires the construction of roads, drilling pads, bridges, pipeline transmission and powerline rights-of-way, airfields, and support facility pads. Most of these facilities require gravel. For the past 15 years, we have limited gravel recovery to certain locations on the field. As the gravel sources have been exhausted at these locations, rehabilitation of the disturbed area follows. We also are conserving gravel by a program of re-use, rather than expanding and developing new gravel source locations. We have asked industry to return to those abandoned pads and roads to recover as much gravel as possible for use on new facility areas. We have also restricted the construction of adjacent new pads to support straight-hole drilling when directional drilling operations could be reasonably accomplished from existing well pads nearby.

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[1]Vibroseis is an electromechanical method of inducing seismic waves into the ground for measuring reflections and refractions from the various strata. The method does not generally give as good detail nor reach to as great a depth as conventional explosive seismic methods, but avoids the necessity of drilling a hole and discharging explosives where environmental or wildlife concerns are important.

Another method of conservation has been the re-use of contaminated gravel. At each of the oil-producing facilities, some maintenance operations necessarily contaminate the surrounding gravel pad. Highly contaminated gravel is dumped at one end of a settling pond to drain out oily residue for several seasons before it is available for re-use. If the contamination is not too severe, we remove and stockpile the gravel for future use rather than bury it. Even if this gravel is slightly contaminated, it is useful as a base for future drilling equipment and other facility set up.

Saving topsoil by keyholing near the construction site is most important because you just cannot replace easily lost topsoil necessary for rehabilitation. Without topsoil, revegetation is extremely prolonged. As facility areas are phased out, surface areas are recontoured to their natural gradient as nearly as possible, seeded, and fertilized. Sometimes within a year, a program will call for another well on a rehabilitated pad, and the rehabilitated surface again will have to be disturbed. We have experienced this several times.

A speaker yesterday commented on the use of gravel on the North Slope and I wondered at the time, the possibilities of gravel recovery from the site if they experience a dry hole. I am not certain such an area can be completely restored but the gravel used in the construction of pad and access road might be available to some other area, eliminating a need to disturb an additional gravel source located perhaps in a streambed.

For the last 10 or 12 years industry has not constructed a new well pad at the Swanson River Field, although several new wells have been drilled. Rather than authorize new construction of well pads and access roads near other developed facilities, we have authorized the extension of existing pad areas to accommodate two or three additional wells directionally drilled from that existing location.

Another concern regards the loss of trees from the natural scene. One unfortunate spinoff of seismic trail construction has been increased spruce bark beetle infestation. These beetles attack mature and overly mature white spruce, especially during periods of drought like those that occurred on the Kenai Peninsula during the late 1960's. More than a quarter million acres of white spruce habitat have been killed by the spruce bark beetle. Much of this kill is located in the Point Possession region, but it extends intermittently throughout the Refuge and western Kenai Peninsula. Many of the trees that were felled for seismic operations also provide the necessary host trees for this insect. Beetle infestation is not limited to seismic trails, however. We observe beetle-infested areas where homesteaders have cleared the land and leave berms of downed trees, later to become host trees for the spruce bark beetles.

In some portions of the Refuge we have known erosion problems associated with past seismic activity when dozer equipment unnecessarily

disturbed the surface area. Because these lands were above treeline and vegetative growth patterns are fragile, the vegetation could not return quickly after topsoil was removed, and a serious erosion problem developed, becoming even more serious in following seasons. Siltation from these eroded soils found its way into streams and drainages and directly threatened the fishery resource.

With the construction of seismic lines and surface oilfield facilities, some wildlife habitat is also lost. Overall, this is not a great loss and the moose have not suffered. At the same time, we have not observed or recorded that the moose population increased as a result of oil development. Some of you, I am certain, have read that oil development on the Kenai has really helped moose, but there are no facts to confirm this. While a small amount of moose browse may revegetate in some disturbed areas, there are many miles of lines and disturbed areas where moose browse does not return. In past years some trumpeter swan habitat also was disturbed and the birds were displaced. This bird species does not accept much disturbance and usually leaves industry-active areas.

In addition, seismic trails and access roads annually assist moose hunters to obtain their share of moose by developing a pattern of access into areas where the moose formerly were undisturbed. A few moose also are road-killed each winter.

Another use of roads built on the Refuge for industry is the access provided sportsmen to hunting areas and fishing lakes. They also provide access to the very popular 150-mile Kenai canoe system. Industry dictated this road placement and the roads are not necessarily where we might have built them. It could have been many years, if at all, however, before the Refuge was alloted funds to build adequate recreational roads.

We do have some problems with unauthorized vehicular access, for instance, unauthorized travel on seismic trails and powerline/pipeline rights-of-way. Off-road vehicle use is not authorized on the Refuge, except for special use permits issued for seismic operations. These permits dictate exactly what lines may be utilized and what routes may be traveled. In addition, some snowmobile use is permitted in designated areas of the Refuge when sufficient snow cover is present to protect vegetation and terrain along the route of travel.

[Editor's note: The remainder of Mr. Richey's presentation consisted of color slides. Because of printing limitations, they are not reproduced here.]

Surface Protection and Placer Mining in the Circle Mining District

John H. Stephenson

ABSTRACT
Increased gold prices and growing population in the Fairbanks area account for the increase in placer gold operations in the Circle Mining District. Surface disturbance problems arise from the need to move paydirt to the sluice box near a water source, from use of hydraulic methods, and from access construction. Some ways to alleviate these problems would be to encourage miners to use settling ponds, and to improve communications between miners and regulatory agencies to plan before construction for access that will least damage the surface.

During the last couple of years, interest has been renewed in placer gold mining activities in Alaska. More than 30 operations are in the Circle Mining District alone. The renewed interest is due mainly to the increased price of gold. Another factor contributing to the new activity is the increase in population in the Fairbanks area. Many of these operations are taking place on d-1 lands in the Circle Hot Springs and Fortymile country. Existing mining access roads that were built in years past lead into these areas.

Most of the mining activities are two- to four-man operations, with some heavy equipment such as cat and front-end loader. They usually have small trailers for summer housing. Some operators are old-time Alaskans and others are newcomers from Outside, up just for the summer. Some never get their operations off the ground. Others are recreational/weekender

miners. The slides you are about to see are mostly in the Circle Mining District about 130 miles east of Fairbanks.[1] This area is accessible from the Steese Highway that runs from Fairbanks to Circle City on the Yukon River.

SLIDE #1 - This is placer gold operation on Deadwood Creek. It consists of a reservoir and sluice box. Placer mining is actually a form of strip mining and has related problems.

SLIDE #2 - Another view of the sluice box. The operator stockpiles the paydirt near this chute. He then opens the gate to the reservoir and begins to sluice. The water supply is temporary, and the miner must close the gate and wait for his reservoir to fill.

SLIDE #3 - Most of the miners in the Circle Mining District are developing bench deposits now that the main paystreaks have been played out. Bench deposits create some problems in that removal and disposal of muck (overburden) and vegetation is necessary. Bench deposits may be far from a water source, so the paydirt must be moved to the sluice box, which must be near water. This creates wide areas of disturbed ground.

This slide shows a bench deposit being prepared for development. The miner must remove approximately 10 feet of overburden before he can sluice the gravel.

SLIDE #4 - Here the miner is spreading the overburden over old tailings. Natural or artificial seeding of these areas could reduce the amount of sediment that reaches the stream.

SLIDE #5 - This is a hydraulic operation on Harrison Creek. The miner is cleaning out rock and gravel from below his sluice. This hydraulic procedure is the most economical means of placer mining, but it is also the most harmful because of all the fine sediments that are washed into the stream; the overburden muck is also stripped in this manner; two giant water nozzles--one above for washing the material through the sluice box and one below the box for removing the sluiced material.

SLIDE #6 - Tremendous pressures are developed in hydraulic operations; huge boulders are moved like marbles when materials are excavated by hydraulic methods.

SLIDE #7 - This is a settling pond which is located below the mining operation. Its purpose is to allow the fine suspended sediments to settle. This pond would work better if the outlet were in the left foreground. Placer miners are being encouraged to incorporate settling ponds into their

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[1]Because of printing limitations, color slides used by Mr. Stephenson in his seminar presentation are not reproduced here.

operation to help alleviate stream pollution during the critical summer months when fish are in the streams. Persuading some miners to do this is difficult.

SLIDE #8 - This pond is ineffective because the stream channel bypasses the pond's entrance, and the dam has no overflow outlet.

SLIDES #9 and #10 - Nevada Gold Inc. setting up operations for next summer on Harrison Creek, a tributary of Birch Creek.

SLIDE #11 - Aerial view of water ditch, with the Steese Highway in the background. The purpose of the ditch is to bring more water to the miner's diggings, especially if the area the miner is working lacks enough water to operate. The ditch has not been in operation to date.

SLIDES #12 and #13 - Profile view of ditch. Disturbed area is about 150 to 200 feet wide. Method of construction was to doze off the vegetative mat and mineral soil and deposit it on the downhill side to form a berm; several breaks have been made in the berm from natural runoff.

SLIDE #14 - Boulder Creek Access Problem. This access road was built over alpine tundra in June 1974 from the existing Harrison Creek Road to mining claims on Boulder Creek. I learned about this operation from a concerned resident in Central. Other miners we talked to in the area were aware of the problem and wanted to know what BLM was going to do about it. Our answer was that we wanted to work with the miner to restore the area and to seek an alternative access route up Boulder Creek.

Fig. 1. (left) Water ditch--aerial view. The ditch was constructed in June 1974 by a miner to bring water to his claims. It has not been used. Located on d-1 lands near Eagle Summit on the Steese Highway, it is about 3 miles long. Fig. 2. (right) Water ditch--ground view. The miner constructed the ditch by bulldozing surface vegetation and mineral soil downhill to form a berm. The disturbed area is about 150 feet wide. Several breaks have occurred from normal surface runoff.

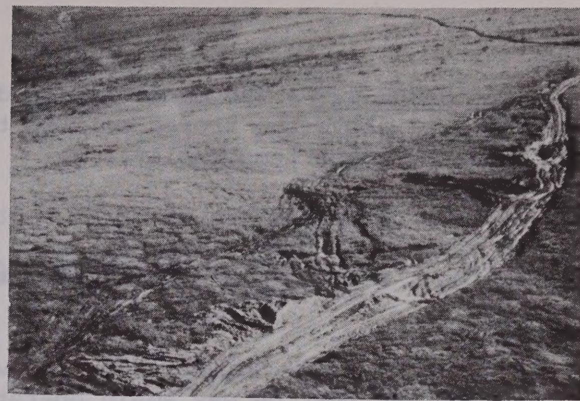

Fig. 3. (left) Mining access road--aerial view. The road was constructed from Harrison Creek road to Boulder Creek claims over alpine tundra with permafrost soils. Located on d-l lands, the road is about 2 miles long. Fig. 4. (right) Mining access road--aerial view. The next summer, the same road became impassable, even with tracked vehicles. The miner had to detour around the soft areas, thus causing additional surface damage.

Fig. 5. (left) Access road--ground view. This road was constructed with a dozer. Surface vegetation and thawed soil were removed so wheeled vehicles could be driven over the frozen ground. It is about 3 feet deep at this place and about 1/4-mile long. Fig. 6. (right) Access roads--aerial view. These ATV trails have been used for years for mining claim access in the Kantishna area. Several miners use these trails with tracked vehicles or other types of ATV's. Some of the trails have revegetated naturally over the years. The trails are on d-2 lands in the proposed Mount McKinley National Park expansion.

SLIDE #15 - The miner had used his dozer blade to remove thawed material above the frozen soil so the road could be used by wheeled vehicles, at least temporarily.

We contacted the miner by letter and over the phone, and he agreed to contact us the following spring before going into his Boulder Creek claims. He also said he was willing to do restoration work on the access road.

SLIDE #16 - Our next contact with the miner was in August 1975, when we learned that he was again operating and had done additional damage along the access route because he had to detour around the existing road in several areas. Some of the additional damage had occurred when he had to use his cat to pull his 2-1/2 ton, 6X6, fuel truck through the soft areas. How could this situation have been prevented? Communications with the miner before the access road was constructed could have resulted in the use of another route. An alternate access route could have been used, with BLM participating in the road location and construction techniques. A meeting with the miner will take place next spring, but after the damage has been done. We hope to develop a restoration plan for the existing route, and the operator has agreed to follow the plan. If the miner does not wish to participate in restoration of the area, the last resort would be court action. As Bob Price said earlier, there is little court precedent in this area. But the mining law of 1872 states that "the miner may be liable for damages if he unnecessarily causes loss or injury to the property of the U. S. in the exercise of his right of access."

SLIDES #17 and #18 - Kantishna mining roads--access for about six operations, by track vehicle.

SLIDES #19 through #21 - Lost Chicken Mine. This placer operation was discharging its effluent overburden into the Fortymile River in 1974. (Bureau of Land Management, Alaska Department of Fish and Game, and Alaska Department of Environmental Conservation were concerned.) The use of settling ponds was suggested by BLM to reduce the suspended particulate in the water before discharge into the river. The miner, however, thought if the silt-laden water could be discharged over a flood plain, the vegetation would filter out the silt, leaving a mud deposit on the surface that would eventually dissipate through the surface vegetation.

Commercial Logging on National Forests

Thomas J. Sheehy

ABSTRACT

Discussed in this paper are past and present logging systems used on National Forest lands in Alaska, comparative surface disturbance of each method, and mitigation and prevention of surface disturbance by preplanning. The discussion applies only to Alaskan maritime forested areas, which have high rainfall and cool climate.

LOGGING SYSTEMS

History

Commercial logging in what are now Alaska's National Forest lands began when a single tree was cut on a beach and removed with a boat or steam winch. The surface suffered little damage, and no signs of disturbance remain.

As early as 150 years ago, Russian settlers logged by clearcutting, taking all except the largest trees. They cut the logs into short sections and pulled them with hand tackle or steam winch to the beach for shipping. Again, there was no lasting surface damage.

In the early 1900's, Alaskan forests were logged for railroad ties, building construction, and mining needs. Logging camps were established. Trees were cut, and the ties were hand-hewn in the woods. Then they were

skidded or hauled on horse-drawn wagons to the beach. Except where access roads for this type of operation remain, only a small amount of surface damage is evident.

A second method of log removal was used for larger scale logging. Much as they do today, loggers rigged trees with cable and pulled logs to the beach with a steam winch. The logged areas were clearcut. In some places in the Chugach National Forest, some damage still is visible 700 to 800 yards back from shore where logs were dragged across muskeg. Deep V-shaped cuts may be seen, some with deeply eroded sides and bottoms.

Present-Day Logging

Although there is some variation, currently used methods of logging may be grouped into four categories: heavy machinery, saltwater A-frame, high-lead or cable, and advanced systems.

1. Heavy machinery system employs Caterpillar tractors (cats) or other conventional types of cleated or tired vehicles. They are used for pulling logs from the felling site to the decking or loading areas. They often cause extreme surface damage.

2. Saltwater A-frame system generally consists of a diesel-powered winch on an A-frame that floats or sits on the beach. Generally, it floats part of the time. Cables are run from the A-frame up the mountain, and logs are winched down the mountain to the beach. Where this type of logging is used on very steep slopes (steep slopes are a prerequisite), a large amount of gouging and land slippage results.

3. High-lead or cable logging systems are familiar to many Alaskans, especially in Southeast Alaska. Generally, either a portable tower, such as a Skagit, is set up and logs are brought from the cutover area to the landing, or trees are rigged with cables and a device called a donkey is used to drag logs to a central location. In a good high-lead system, most surface disturbance results not from actual logging but from construction of roads to the site and at the landing and decking areas.

4. Advanced systems are of several types but we'll limit our discussion to helicopter and balloon systems. Helicopters and balloons are used to lift logs from the cutover areas to the landing site. Chances of surface disturbance are slight, except where access roads must be built to landings.

SURFACE DISTURBANCE HAZARD RATINGS

From field observations of these four systems, I have rated each system according to the amount of surface disturbance it is likely to cause. Fig. 1 shows these hazard ratings. In making the hazard ratings, I have assumed that each system is used where slopes are fairly gentle (less than 30 percent) and sites are relatively stable. Many other

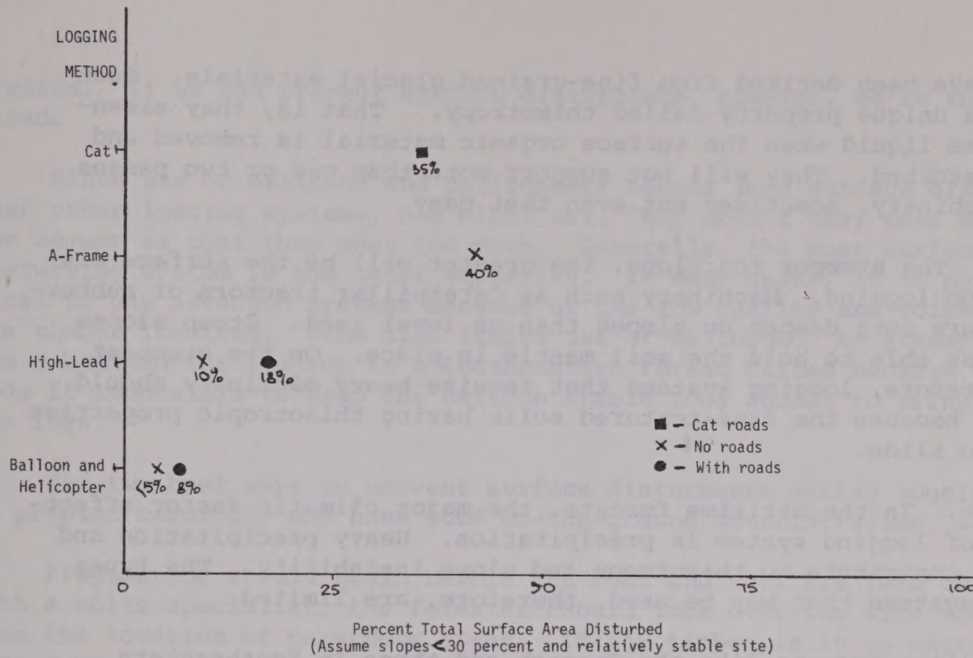

Fig. 1. Comparative hazard ratings of four logging methods.

factors may affect the amount of surface disturbance caused by the diffe ent systems, however. These will be discussed later.

Highest hazard ratings were assigned to the A-frame and the heavy machinery systems (40 and 35 percent respectively). Two ratings, a high and a low, were assigned to the high-lead and the balloon and helicopter (advanced) systems. The lower rating does not include probable surface damage from building access roads to the site; the higher rating does. If roads are built to bring logs out to the mills, the hazard rating for the high-lead system rises from 10 to 18 percent and for the balloon or helicopter systems from 5 to 8 percent. Although both systems may require some roads, the balloon and helicopter systems generally require fewer than the high-lead. This explains the lower hazard rating.

FACTORS DETERMINING SURFACE DISTURBANCE

Four major factors determine the amount of surface disturbance likely to result from logging. They are soil type, slope, climate, and access road construction.

Soil type. Disturbance from logging is greatest where the soil texture is fine. A rule of thumb is: The finer the texture of the soil, the more surface disturbance you can expect. Where soil texture is very fine, it is almost impossible to use heavy equipment such as cats or conventional cleated machines. Such soil types are common in the maritime forests of Alaska where rainfall keeps soils saturated most of the time

and soils have been derived from fine-grained glacial materials. Such soils have a unique property called thixotropy. That is, they essentially become liquid when the surface organic material is removed and they are disturbed. They will not support more than one or two passes by heavy machinery, sometimes not even that many.

Slope. The steeper the slope, the greater will be the surface disturbance from logging. Machinery such as Caterpillar tractors or rubber-tired skidders cuts deeper on slopes than on level land. Steep slopes also are less able to hold the soil mantle in place. On the steepest slopes, therefore, logging systems that require heavy machinery should not be used because the fine-textured soils having thixotropic properties will tend to slide.

Climate. In the maritime forests, the major climatic factor affecting choice of logging system is precipitation. Heavy precipitation and moist soils contribute to thixotropy and slope instability. The types of logging systems that may be used, therefore, are limited.

In maritime forests like the Chugach and those in Southeastern Alaska, soils are moist all of the time and saturated a good part of the time. In many places it is impossible to move heavy equipment directly across the soil surface and high-lead or advanced systems must be used for logging. Access roads have to be of the overlay type.

In winter, however, if the surface is frozen and protected by enough snow, it may be safe to use any logging system. In the maritime areas, even though soils freeze only a few inches deep, logging can be done more efficiently and with less surface disturbance by heavy machinery than by other systems for which roads must be built to get the logs out. It is, however, necessary to limit heavy machinery use to gentle slopes. Correct timing and close supervision are necessary.

Road building. Construction of access roads to logging sites contributes heavily to surface disturbance. Even if surface-disturbance-limiting systems, such as high lead, are used for logging at a site away from saltwater, access roads must be constructed to move the logs to a saltwater landing or an existing road. Disturbance occurs both from actual construction of the road prism and from borrow material removal.

Steep slopes that are slide prone are found in many parts of Prince William Sound and Southeastern Alaska. Roads cut around the hills there can trigger mass failure that disturbs the surface over many acres. Road building causes minor slips and slumps as well as massive landslides. Problems with sedimentation, regeneration, and further instability also arise when soil materials slide. Referring to Fig. 1, we see that surface disturbance hazards of the least surface-disturbing systems are increased when road building is added to the systems' use.

MITIGATION AND PREVENTION OF SURFACE DISTURBANCE FROM LOGGING

We can repair some surface damage by fertilizing and seeding with

grasses. If we can prevent surface disturbance, however, we're further ahead.

Since use of balloons and helicopters causes less surface disturbance than other logging systems, one might ask, "Why aren't they used more?" The answer is that they cost too much. Generally, the most surface-disturbing system is the least expensive. In many cases, it is not practical to use advanced systems because of the low quality and volume of the timber involved. Wind also limits use of balloons. An attempt to use a balloon for logging in a Southeastern forest failed because winds made it impossible to keep the balloon stable long enough to bring out the logs.

The two best ways to prevent surface disturbance during logging are to preplan carefully and have good on-the-ground administration.

Preplanning should begin before the road and unit are laid out. With a soils specialist, the forester should look over the site and determine the location of hazardous areas. If the timber is in an extremely hazardous area, the best solution may be to leave it alone and not try to log it. If the area must be logged, it may be possible to plan roads where they will cause little surface damage.

Planning should be reflected in sales contracts, where specific restrictive clauses can be written to protect the surface.

In order to enforce restrictive clauses, forest personnel in the field must know the logging sale contract. As on-the-ground administrators, foresters can learn to recognize hazardous areas and take steps to prevent surface damage. They must be committed, however, to seeing that the surface is protected. The logger also should be helped to recognize potential problems and be made to feel that it's in his interest to cut and remove timber with minimal surface damage.

To demonstrate the value of preplanning, we might look at a hypothetical situation faced by soils scientists and planners. Fig. 2 shows an extreme situation of a site where the slope is steep--more than 80 percent, but which has an excellent conifer cover and a logger wants to harvest the trees. We go to the field and find that the soil is extremely fine textured. It's volcanic ash and highly weathered. Looking at the topography, we see that an alluvial valley is at the bottom of the slope. Alluvial terraces are on both sides, and a stream with a large run of salmon runs through the valley.

We want to prevent slides or slips during logging, and we want to keep sediment out of the stream. We also want to harvest the timber.

Here are some choices we can consider:

1. <u>Cut all the timber</u>, using a high-lead system (a cable system with a portable tower). This system requires a road halfway up the slope

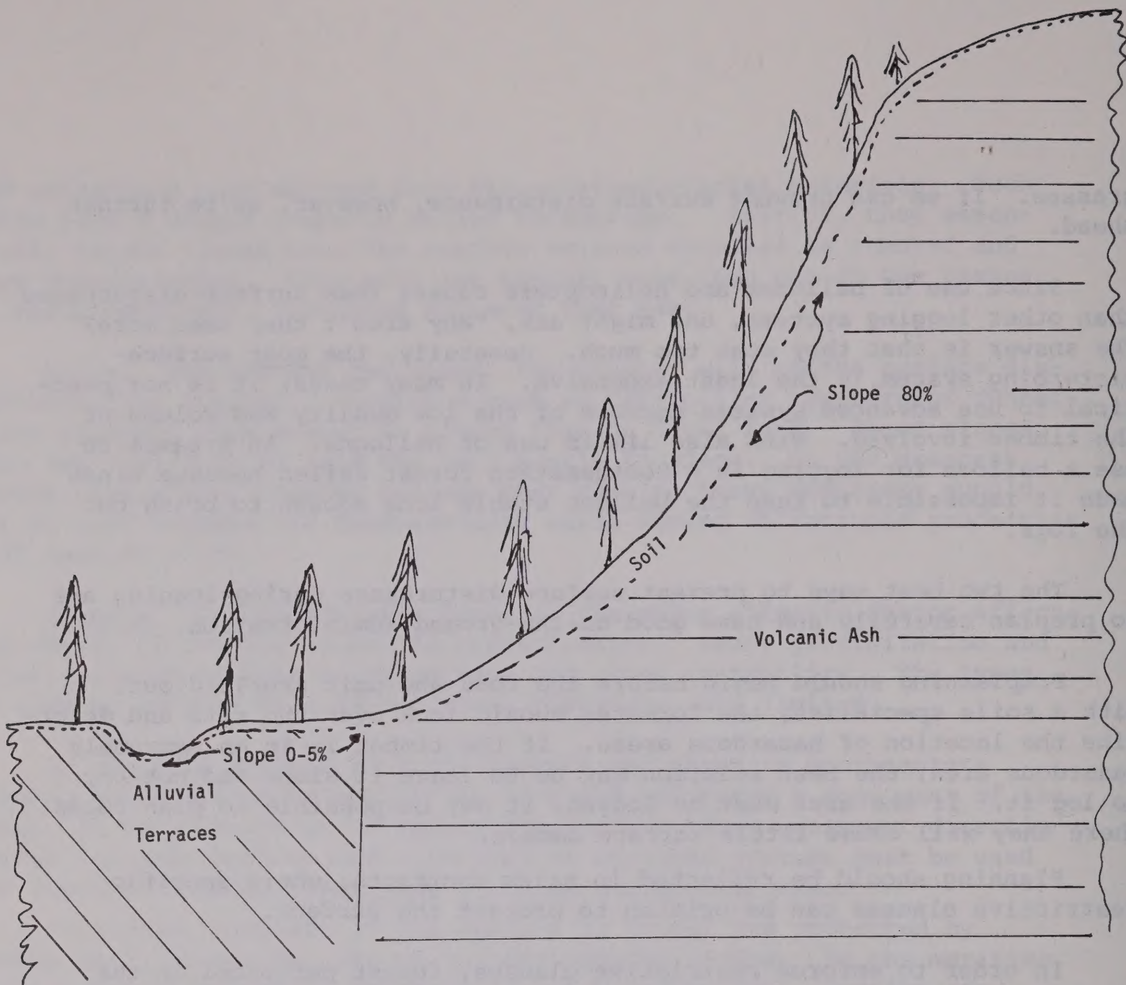

Fig. 2. Cross section of landscape with soils and slope problems for logging operations.

and downhill logging on the top half of the unit. Chances are about 100 percent that we'll lose a lot of the hillside from landslides and other disturbances if we log in this manner.

2. Log only the lower half of the slope, building a road at the bottom of the slope. Here, limiting the logging to the most stable area where the slope is gentle reduces slide and slump hazards. Some surface disturbance still may occur, especially if the road undercuts the toe of the slope. Another problem is that we get less timber than with the first option, and the sale may not be economical.

3. Use an advanced logging system. Checking our hazard chart, we see that we can keep surface disturbance to 5 or less percent of the area if we use helicopters or balloons to lift out the logs. Instability problems may develop later, however, when timber is removed from extremely steep slopes with volcanic ash soils.

4. Do not log at all. This may be the best choice although it may be difficult to convince the land manager because of the loss of economic gain from sale of the timber.

Surface Protection and Mining Activities

George R. Schmidt

ABSTRACT
Mineral development by its nature is surface disturbing. It is, however, necessary. Underground mining produces the least waste material, some of which can often be returned to mined-out areas. Other tailings can often be stabilized by vegetation. Surface mining is extremely varied, but calls for opening the surface and removing the waste material. Disposing of waste in an acceptable manner is often difficult due to terrain, lack of water, and sterility and other qualities of the material. Land cannot be rehabilitated during use. Rehabilitation should include acceptable uses other than revegetation.

Mining activities, including oil and gas extraction, by their nature are surface disturbing. Yet, after potable water is provided and food raised--other surface-disturbing activities--mining is the single most important activity in which man has ever engaged. From pre-Neolithic times through today, man has used the inanimate, or nonrenewable, resources found in the earth's crust to maintain himself and to make life better, easier, and pleasanter for himself, his family, and his neighbors. Today, the term "neighbors" includes everyone on the face of the earth.

Although they are surface disturbing, mining activities cover only a small part of the land, an estimated 16 hundredths of one percent of the United States since 1930. There can be no argument that that small amount of surface has been greatly changed by industry. Whether or not all of

that surface disturbance has been necessary is open to question. Certainly we must look at the technical feasibility and environmental awareness that existed when the disturbance was made. Since more cubic yards--tons, if you prefer--of rock are being mined and moved today than ever before, however, we are primarily interested in what can be done at this time to prevent further unnecessary damage. I must emphasize "unnecessary" because, as I indicated, surface disturbance is an integral part of any mining operation.

Mining methods have been classified and subclassified in many ways. For our purposes, we'll refer to surface mining and underground mining. The less disturbing, normally, is underground mining, although that depends on many variables, such as amount mined, how close to the surface, the quality of the bedrock, and what is on, or is placed on, the surface.

Underground mining is expensive, costing an average of three to four times as much as surface mining. For that reason, a minimum amount of waste is removed. But everything taken out must be placed somewhere else. Waste rock is piled in some predetermined area, preferably where it won't have to be moved a second time.

One of the major expenses in any mining operation is power. Where underground mines are in hilly country, the waste rock is commonly allowed to flow over the hillside just outside the portal, or mine entrance, thus using gravity to provide the power needed to move the rock.

The ore is then concentrated, usually by grinding and collecting the mineral. The remaining 99 percent or so of the ore is waste and must be discarded. Normally, the waste tailings are very fine, almost a powder, and will blow about in the wind if scattered and not protected. In recent years, the Bureau of Mines has done extensive research in attempting to stabilize these tailings, particularly those resulting from the concentrating stage. The method used is to encourage plant growth on tailing piles. Because tailings are sterile and often acidic, special fertilizers and conditioners must be applied. Generally, few plant varieties will grow, and large quantities of water may be needed to sustain growth. Rehabilitation requires maintenance over a considerable period. Meanwhile, more tailings are being deposited, so the problem is continuous.

In some mines, some tailings can be deposited as slurry in mined-out sections. As the slurry settles, the water is pumped out and the solids are left behind, filling the voids, supporting the open rock, and not blowing around the countryside.

For several reasons, it is not always feasible to backfill. The shape of the mine may prohibit it. More commonly, when mining is halted, the mineral that is left behind is too low grade to mine, but projections indicate it can be mined economically in the future. Mineral conservation requires that the mine be left in condition to reenter for extracting that lower grade material in the future.

Surface mining takes many forms. Recently, the coal mine operations in the western states have received considerable attention. Previously, the Appalachian coal mines were a matter of national concern. Open pits, such as the Bingham Canyon operation in Utah, are well known. Placer operations of several types occur around the country. On smaller scales, mineral material (sand, gravel, rock) sites are common throughout the country, and quarries are part of the landscape in suitable areas. Each is a different type of operation, but all have one thing in common; they cause substantial surface disturbance.

There is no way to mine from the surface and at the same time preserve it. The object, therefore, is to disrupt a minimum amount of surface and to rehabilitate as much as possible. Both terms, "minimim" and "as much as possible," are subjective, interpreted differently by different people. But the day is past when the miner, particularly the surface miner, can look at his operation as taking place in a vacuum. What he does affects the land around him. The total cost of his business must be computed and passed on to the customer. If the total cost is too high for the market, it is obvious that the operation cannot be run profitably at that time. The customer--that is, the consumer, you and I--must be made to realize that the cost of mineral products will go up as extraction costs rise. This, of course, contributes to the general inflationary trend. But as long as increased costs must be paid in money, as opposed to, for example, less pure air and water, we must accept them and the problems associated with them.

Surface damage from surface mining occurs primarily from two actions, mining operations and placement of waste material. When mining operations are carefully planned, the maximum amount of ore is removed. In this sense, I use the word "ore" to include all of the desired minerals, whether metallic or otherwise, including mineral materials and fuels. Anything less than maximum recovery is a poor utilization of the deposit. If the mine development is carefully planned, there is little reason for unnecessary damage, such as from careless opening or careless road building.

Disposing of waste material is the most difficult problem, where good planning and rehabilitation are the considerations. It is impossible to generalize because the situations vary so widely among not only different types of surface mining but also among various mines of the same type. There are, however, a few actions that are necessary such as removing surface material and disposing of it and other waste material.

Almost always, the overlying surface material must be moved to expose the mineral sought. Almost always the surface material is composed of topsoil and underlying sterile material. Because cost of moving the material is considerable, the goal is to move it only once. Under today's conditions, however, that is not always possible. Operators of coal mines, quarries, and other surface mines now remove the topsoil and store it separately from the sterile material. In situations such as the coal fields of the northern plains, the coal is then mined in a long open cut.

The sterile material from the next cut is then put in the first cut and the second slice of coal mined. Topsoil is replaced over the material and replanted or reseeded. In that area, because of the aridity and the poor quality topsoil, growth is slow. Growth is further hindered by animals cropping new plants. But given time and effort, the land will restore itself.

In some areas, such as Appalachia, where the terrain is steep, placement of the waste material is a real problem. Normally, handy valleys are used, but time has shown us that that is not always a good practice. Waste material gets into the water, often changing the pH, its acid or basic character. In other cases, in order to keep the waste from flowing downstream, a dam is built to contain it. But dams have broken with catastrophic results. In such areas, and this applies to all mountainous lands with narrow valleys, no single particularly successful plan has been devised.

In the southwestern desert, where tremendous quantities of material must be moved, both waste and ore, new hills of waste material must be built. At Twin Buttes, Arizona, conditions were favorable for a unique waste disposal system. The sterile waste rock was piled in such a manner as to form a pond for the slurry resulting from the concentrator. The sides of the dump have been fertilized and seeded so the area now looks like one of the mesas that characterize that country.

Not every mine operator can come up with such a plan. In some mines the waste rock will not hold a slope or support other material or it may decompose and blow away. In others, waste turns to a cement-like mass that defies revegetation. In any case, the area cannot be rehabilitated while in use, and it may be active for a long time. The Bingham Canyon operation is more than a hundred years old.

We must look at rehabilitation from a broader perspective than just revegetation. In the Midwest, gravel pits have become prime real estate or parks. Quarries have become swimming pools or fishing holes. Dredge tailings have become sources of crushed rock and valuable real estate, particularly in the Sacramento area. In Nome, dredge tailings support the airport, the Beltz School, and the Department of Highways station. In Fairbanks, tailings provide a firm base of thawed ground for a Golden Valley Electric Association substation, paved highways, and the community of Fox. We are all familiar with the mines that have become not only tourist attractions, but recreation centers. With an increasing need for land for intensive use, a little imagination will transform most abandoned mines into a productive second life.

Not directly related to mining operations, but necessary adjuncts, are activities related to the search for minerals. Concentrations of minerals in usable amounts are scarce; so scarce that, in light of man's need, their presence seems almost a miracle. We receive nothing for nothing, however, and the greater the value of the prize, the more effort

we must exert to attain it. Ore deposits are no exception.

Because of the extremely rare occurrence of ore deposits, it is necessary to conduct wide searches for them, using many different methods. This phase of the work is not purely a science, it is still somewhat an art. In order to find hidden deposits, the searchers--prospectors--must cross and examine all types of land. If access is denied, some land cannot be examined. This could result in the loss of a critical deposit.

In the past, because of the large amount of public land, land for which there was no other apparent need or use, few people were concerned about the condition in which the land was left. Today, because of the use of heavy equipment, involvement of more people and their use of the land, the shrinking quantity of public land, and most of all, the development of awareness of the need for maintaining a stable environment--of which this seminar is evidence--careless cross-country travel is no longer tolerable.

In most parts of the United States, cross-country travel may leave traces, but otherwise does no serious damage. In many parts of Alaska, however, it can result in serious ground destruction that may take many years or even generations to restabilize. An example is where vehicles crossing ice-rich permafrost break through the vegetative matting. This permits heat to reach frozen material beneath, thawing it. Commonly, the thaw continues until a new point of stability is reached. If the cut is on a slope, even a slight one, the material will flow, leaving a gully. Where there is any scraping in such an area, the situation becomes a disaster.

Although the land must remain open to exploration and access for exploration if we are to continue to replace exhausted mineral deposits, care must be taken in crossing land surface. Various solutions to the problem have been proposed. Most involve evaluating proposed plans, reviewing affected resources, and issuing permits of one sort or another, with attached stipulations. If such permits can be processed in an expeditious manner, prospectors might have no serious objection. Expeditious treatment is necessary because unlike a corporation, the prospector must plan his work in terms of short-term financing and brief time periods. He must also make reasonable showing before he can interest a development company in the property.

At present, expeditious processing probably is not possible since the details of every area are not known. Presumably, if the application describes a fragile route, a more acceptable one would be suggested or permitted. This requires that the approving agency have some detailed knowledge of all the land under its administration.

There can be no doubt that the most effective means of preventing surface disturbance is to educate those who use the lands. This must be done through all of the organizations that contribute to our educations--

homes, schools, newspapers, and all other information sources. A one-shot pamphlet or a government threat will do little good. A permit system is only as good as its surveillance system.

Before inviting questions, I want to apologize for treating this very complex subject in a simplified manner. Each mine or exploration program has unique problems. It would take far more time than could possibly be made available here to go into the major specific problems. In addition, I have committed the same sin of which we often accuse the mineral industry. I have talked about the subject in a vacuum. I haven't related it to the price of minerals which in most cases, is set in the international market. I haven't related it to balance of payments, nor to migration of industry abroad, nor to national security, nor to the presence of possible contaminants, such as trace amounts of heavy minerals in waste water, nor to community needs and community desires, nor to scarcity or abundance of minerals in terms of their present uses, nor to long-range planning. The latter should, of course, be in terms far beyond our lifetimes or the lifetimes of our grandchildren.

User View of Regulations and Permits

Frank A. Therrell

ABSTRACT
Operations and maintenance of the trans-Alaska pipeline system under the stipulations governing the federal and state right-of-way are reviewed. Also presented are technical permit requirements with other government agencies that might affect pipeline operations and maintenance.

As many of you know, Alyeska Pipeline Service Company is responsible for the design, construction, and operation of the 48-inch pipeline being built from Prudhoe Bay to the terminal at Valdez. The project is a little more than 50 percent complete. We expect work on the pipeline proper to be completed toward the end of the year. Construction on the pump stations and terminal will continue into 1977, and the schedule calls for putting oil on board tankers at Valdez about June or July 1977.

We had to obtain a number of permits, which we refer to as technical permits. There's a fine line that we have to draw between permits and permissions. Our legal department gets us permission to occupy the land. They deal mainly with the State Division of Lands and the Bureau of Land Management, the major land owners connected with the pipeline project. Project Permissions, which I manage, then obtains the right to start work and to continue working on the land under the stipulations of the right-of-way agreements and other statutory agencies such as the Corps of Engineers, Coast Guard, Highway Department, etc. We have about 1,200 technical permits on this project, an average of about one and one-half permits

per mile for 800 miles of line.

About 65 percent of the property crossed by the line is federal land, about 30 percent is state land, and the remaining 5 percent is private property across which we have right-of-way easements. In some cases we have purchased the property in fee. For example, Alyeska owns land in fee for several pump station sites and the terminal site. You may have visited the valve test site near Fairbanks; it is on fee property.

I'll begin by discussing technical permits for rights-of-way. We have two documents, basically, to deal with. First is the right-of-way lease with the State of Alaska for property that belongs to the State. Second, we have an agreement and grant of right-of-way from the Department of the Interior for federal land that is administered by the Bureau of Land Management. The State Pipeline Coordinator's Office under the Alaska Department of Natural Resources works with Alyeska to review and perform surveillance on pipeline activity on state lands. An Alaska Pipeline Office performs the same functions for activities on federal lands.

On private lands, we deal directly with the owner, and our right-of-way agreements include certain stipulations that we have to abide by in the construction and operation of the pipeline system.

The stipulations in the state right-of-way lease and the federal agreement and grant of right-of-way have been condensed and printed in a hip-pocket size book for easy field reference. All our supervisors and government agency personnel thus have a ready reference to the stipulations in the state and federal documents.

George [Schmidt] mentioned the need for government agencies to get together a text on operations across the ground surface. Perhaps this will be an outcome of this seminar. Before the Alyeska project started, a great deal of research and study was done in Alaska. I was involved in a study on arctic pipelining two years before the first well was drilled at Prudhoe Bay. I made a complete study of all the arctic literature on ground effects and anything else connected with pipeline construction that we felt might affect it. The study was in conjunction with our Imperial Oil counterpart in Canada's Northwest Territories. Even earlier, we had had experience with pipelining in the subarctic in northern Alberta, and with seismic exploration in the Northwest Territories and in Yukon Territory.

In arctic construction, many decisions must be based on common sense. I think there is a great need, however, to educate workers about problems they face in crossing different terrain. For example, when I was a district engineer in a Louisiana pipeline district bordering the Mississippi River, we had loess deposits where banks were cut almost vertically. These deposits had been standing for years. In building pipelines, we

had to be careful to cut through the deposits just right and maintain the banks or they became a terrible mess during the cloudbursts that are common there. We had erosion and maintenance problems that had to be solved to keep the pipeline going.

In the Arctic, we have a combination of hydraulic and thermal erosion to contend with. When you have both kinds of erosion in some fine-grained soils, the problem is horrendous. We knew this when we began building the road from Livengood to the Yukon in 1969, and we knew we shouldn't cut some of the hills there. Some of the people hired to build the road, however, were accustomed to building roads in temperate zones and climates. They used the same methods they had been using for years, although we argued against it. They soon learned and by the time they got to Hess Creek, they decided we were right. They stopped cutting and for the rest of the road built on thaw unstable soils, they used the overlay technique.

On the road north to Prudhoe Bay, someone made a mistake and cut a slope off the Sagavanirktok River. We ran into a massive amount of ice and had a classic ice cut melting. I think the experience may have been worthwhile because it educated a group of newcomers to the Arctic that they must pay attention to principles of arctic engineering.

Our experience on this pipeline has brought benefits that are certainly going to be used on future projects. If the owner companies move on to new arctic projects and if engineers and other project designers take the trouble to explore the literature and learn from the experiences of others, they should be able to engage in additional industrial activities in Alaska and other arctic regions without damaging the surface significantly.

I'd like to return to discussing the stipulations and some of the constraints we live with. In both the state and federal documents, the general and environmental stipulations are almost identical and include a regulation concerned with public improvements. These are utilities, existing roads and trails, fences, and ditches. Fortunately, in Alaska we don't have many fences.

We have a common agreement with the utility companies for crossing their easements and vice versa. Sooner or later, they're likely to want to cross the pipeline, and we already have mutual agreements as to how we will cross one another, what precautions will be taken, and other considerations.

On the roads and trails, both stipulations and common sense provide for maintenance of existing roads and trails that parallel or cross the pipeline so traffic can be regulated. Because there are so few existing roads and trails in Alaska, we have tried to utilize them as much as possible to provide long-term access for the operation and maintenance of the pipeline. In planning road stipulations, we have had to take into

account the nature of the traffic on each road. For example, if the pipeline is elevated across a road, it must be high enough to permit normal traffic to pass under it.

For fences and ditches, we have similar considerations. On pasture land we may have to build temporary fences to restrain livestock or where we must cross fenced private property, we may have to maintain the fence. At ditches and other drainages, we've got to provide for essentially uninterrupted flow, so we don't create fish ponds in someone's front yard.

We'll move along to the regulation of public access. Regulations require that we restrict access on the pipeline right-of-way. By building barricades, posting, or patrolling, we can try to restrict the general public from coming into construction areas. At road crossings where traffic must be temporarily bypassed, precautions such as lights, signals, and barriers are needed to keep people from being injured. Our legal and insurance staffs are very strict about these precautions.

Another stipulation concerning public access to the right-of-way is that if the Authorized Officer or the State Pipeline Coordinator requests, Alyeska would open a portion of right-of-way to the public for access to recreation areas or campsites. Later, it might be advantageous to the general public to open parts of the construction pad to allow multiple use of the right-of-way. Safeguards would, of course, have to be taken. We hope, however, to see most of the right-of-way restricted from broad public use, to prevent erosion and the need for revegetation and rehabilitation.

Stipulations require us to prohibit camping, hunting, and fishing within the pipeline right-of-way. The pipeline right-of-way on federal land is only 54 feet wide, so unless it crosses a choice fishing hole, hardly anyone would want to fish there. The same is true of camping, although in some areas, someone might want to camp overnight on the right-of-way. For the public safety, this has been discouraged. Currently, fishing is restricted for five miles on either side of the line. This is not an Alyeska restriction; it is a State Fish & Game restriction that we must abide by, and we so instruct our people. The stipulations along this line require that all new employees, including contract workers, be given environmental briefings. With the turnover we've had and the numbers of people involved, more students probably have been educated in this one subject, the environment in Alaska, than any other in Alaska's history.

Fire prevention and suppression are also regulated. If fire starts on the right-of-way, we are responsible for controlling it and putting it out, particularly if it is in the immediate area of a facility such as a remote control gate valve or a pump station. By law also, we must work with the Bureau of Land Management, which administers fire-fighting activities throughout the State, to suppress fires on the right-of-way.

Surveillance and maintenance activities include safeguards for public health and safety. We have to see that the general public doesn't fall into a ditch or otherwise become subject to injury from our operations.

Pipeline system integrity, I think, is a matter of common sense. Everyone can appreciate that builders of a pipeline system the size of the trans-Alaska project or one even a tenth its size, could not afford to have it break down every Tuesday at three o'clock. We must have a pipeline system that operates 365 days a year, 24 hours a day, and keeps the oil flowing. In a trucking business, the trucking fleet has to be maintained to operate at the manager's beck and call. The situation is the same with the pipeline. All we're interested in and want here is to transport crude oil. The pipeline doesn't even own the oil; we just get paid for moving it. In that respect, we're just like a trucking firm getting paid to move a barrel of oil from A to Z.

Communications is also covered by stipulations. We probably have as sophisticated a communications system on this project as anywhere outside of the space program. We have the most modern microwave system imaginable, backed up with a satellite program. A double computer system in the operating terminal at Valdez will feed out information for the operators. People stationed at the pump stations will not normally operate the stations, but will provide preventive maintenance. In case of a communications system outage, they can operate the system manually and shut it down.

session four

CHAIRMAN: Walter B. Parker
Commissioner of Highways*
State of Alaska
Juneau, Alaska

SURFACE DISTURBANCE--continued

Construction of Public Facilities and Utilities

*In March 1976, Mr. Parker resigned as Commissioner of Highways to accept an appointment as State Co-Chairman of the Federal-State Land Use Planning Commission for Alaska.

+ Mr. Ebner died in July 1976 in a climbing accident on Mount McKinley.

Surface Protection as it relates to Construction of Highways, Airports, and Railroads in Alaska

Walter B. Parker

ABSTRACT

In populated areas, the construction of highways, airports, railroads, and other transportation facilities is constrained by existing land-use patterns and population distribution. In constructing such roads as the Yukon-Prudhoe Bay Road through relatively uninhabited and unused terrain, it is possible to utilize techniques which minimize effect upon the surface of the earth. The poor soil conditions which prevail over much of the Arctic and Subarctic prevent the use of balanced roadbed construction techniques that utilize *in situ* materials in the right-of-way. Normally, it is necessary to obtain roadbed material from scattered sources. Often, roads are built solely for access to the material sites. Minimized use of material and spoil disposal sites that require lengthy access roads is probably one major goal that should be emphasized above all others. A knowledge of soil conditions along the generally proposed right-of-way makes it possible to stipulate the available material sources to be used for construction. Similarly, if the road can be constructed with minimum spoil disposal, it is possible to minimize surface damage. The relationship of roads to side slopes and their effect on drainage patterns is another vitally important construction consideration. The same general techniques should be utilized for all construction, varying only with different requirements for roads, airports, railroads, pipelines, and other transportation forms. Roads and pipelines have the fewest constraints and, therefore, are the most easily adapted to varying situations.

In populated areas, the construction of highways, airports, railroads, and other transportation facilities is constrained by existing land-use patterns and population distribution. The esthetics of surface protection are often as important as the protection of structures, and both objectives must be encompassed in surface protection techniques.

In constructing such roads as the Yukon-Prudhoe Bay Road through relatively uninhabited and unused terrain, it is possible to more fully utilize techniques which minimize the effects upon the surface of the earth. Here again, however, some techniques are designed for surface protection only and are aimed at the elimination of erosion and general rehabilitation of the earth's surface. Other surface protection techniques are designed primarily to enhance the integrity of the road prism or other structures.

In any case, whether working in populated or unpopulated areas, the builders of transportation facilities in Alaska must overcome the different problems inherent in several major ecological provinces. The techniques used in Southeastern Alaska and along the Gulf Coast are totally different from those used in the higher mountains of the Alaska Range and the Brooks Range. An entirely different set of requirements is present in building roads in the great Interior valleys and the lower mountain ranges of the Interior. In addition to widely varying soil conditions in each of these provinces, different permafrost regimes must be accounted for. All of these require some variation in surface protection techniques.

To the citizen, the esthetic values of surface protection are probably paramount; but to those who must maintain and rebuild Alaska's transportation intrastructure, the engineering demands of surface protection must assume at least equal value with esthetics. There is no real reason, however, why these two problems cannot be combined. In building in the populated areas, the actions of land managers outside of highway and railroad rights-of-way have great effect upon the surface protection techniques which must be utilized. The coordinative techniques which are being developed among those responsible for land management, fish and game management, urban planning, utilities, and transportation improvements are being fine-tuned. Through the advent of such structures as AMATS in municipal areas and cooperative federal-state management systems in the rural areas, we hope to be able to avoid the types of past mistakes which have resulted in incompatibility of objectives among the various managers.

The controversy over herbicides may be used to illustrate the difficulties inherent in the division between surface protection aimed at preserving engineering structures and surface protection, such as revegetation, aimed chiefly toward esthetic goals. In many cases, alder is the ideal plant for revegetation because it recolonizes rapidly. For the builders of roads, airports, and railroads, alder presents real problems because it opens the roadbed to infiltration from surface runoff and a dry roadbed is one of the first objectives of a design engineer. The Department of Highways, the Alaska Railroad, and other organizations have worked out

complicated surface protection techniques involving utilization of grasses, both exotic and domestic, to form mats to protect the surface as well as the engineering structures' integrity. Often, alder and other native types intrude upon these grasses and disrupt the objective of maintaining roadbed integrity. The best means of maintaining one plant community while eliminating another has thus far been to apply herbicides. However, unfortunate past practices involving herbicides, such as indiscriminate spraying, have resulted in great brown areas along roads. The use of the wrong herbicides has resulted in pollution of surface waters. A great public reaction against herbicides has grown--a very justified public reaction.

Techniques now have been modified to apply herbicides and prevent the growth of alder and other undesirable species, rather than to apply them after the pest plants are grown and leave dead forests along the roadbed. Techniques also have been developed for using herbicides which are not dangerous to fisheries, microtines, and other members of the biotic community. Neither is the public nor am I fully convinced, however, that herbicides are desirable for use in surface protection. It is going to take a massive educational effort to undo the errors of past years.

The Department of Highways is working closely with the State Department of Environmental Conservation, EPA, and land management agencies to develop common techniques that will be acceptable to the public and protect the surface, both for esthetic reasons and to maintain our engineering structures.

A prime consideration in establishing new roads is to select routes where fewest possible material and spoil disposal sites are needed. Unfortunately, in most of the Arctic and Subarctic, poor soil conditions prevent utilization of balanced construction techniques, using in situ materials from scattered sources for the roadbed. To minimize both cost and environmental damage, however, the road right-of-way, whether for highway, railroad, or other surface transportation, should always be selected so as to minimize the need for lengthy access roads to material sites or spoil disposal sites. Use of arbitrary rights-of-way which are fixed by inflexible rules of land managers interferes with overall environmental control and with surface protection in general. Only if we maintain the flexibility to seek the best engineering solution will we be able to make the best use of surface protection techniques.

The Department of Highways is continuing its long-term program of collecting knowledge of soil conditions along the generally proposed rights-of-way in the State of Alaska. Obtaining this information is expensive, but we feel that it is one of the most justified expenses of road reconnaissance. We hope the great outpouring of information on Alaskan soils that is resulting from the Alyeska project will be catalogued and made available to all agencies. It can form the nucleus for a bank of soils information from which all can build better facilities.

The same situation exists in the revegetation programs. We are gaining a great deal of information on restoration and revegetation in a hurry, and it is vital that some monitoring system be established. The Department of Highways is prepared to do its part in any cooperative effort in this regard.

The relationship of roads, railroads, and pipelines to side slopes and the effects this has on drainage patterns is another vitally important consideration in surface protection. The same general techniques should be utilized for all construction, and these vary only with different requirements for roads, airports, railroads, pipelines, and other transportation forms. Roads and pipelines have fewest constraints and, therefore, are the most easily adapted to varying situations of terrain materials.

Already, there are signs of severe headward erosion in spots along the North Slope haul road because adequate surface protection measures were not taken where drainage patterns were changed. Usually, this occurs where sheet drainage flows have been channelized through culverts and the surface protection has not been carried forward far enough downslope to reflect the change from sheet drainage to channelized drainage. Especially critical are areas where the road parallels the lip of a stream terrace or in similar situations where rapid erosion can occur.

In the more populated areas, it has been most disheartening for those who build highways to watch the contempt with which that part of the public that uses the highway rights-of-way for off-road vehicle recreation has treated surface protection efforts. As everyone who has been involved with surface protection has found, these efforts are very expensive. Highway departments or other transportation agencies cannot be expected to pour funds into bottomless pits where each year's effort is wiped out because the public refuses to respect restoration efforts. All land managers have faced this problem since off-road vehicles were first designed for recreational uses. My only point in bringing up the problem now is that it is a <u>joint</u> problem of the transportation agencies and the land managers and must be treated as such. The Highway Department and other transportation agencies are frequently expected to absorb the entire brunt of off-road vehicle use along their rights-of-way when severe restrictions are imposed by land managers on adjacent lands. If we are to provide for off-road vehicle use, we need sufficient time to plan and build trail systems, rather than allow off-road vehicles indiscriminately to roam over freshly seeded cut slopes and other restoration efforts in the right-of-way.

As Governor Hammond said in his State of the State message last Wednesday, we have a chance with the North Slope haul road to do a unique job of interagency and intergovernmental planning in relating transportation, economic, and land management objectives. He has asked me to chair a working group for the State which will coordinate state objectives and budgets for the area affected by the North Slope haul road. We will be

working with all affected agencies to insure that our efforts are mutually constructive and our objectives not at cross purposes.

We have already taken preliminary steps in this regard and this effort will be strengthened. I think that anyone who has taken an objective look at the new construction on Alaska's highways and airports in the last few years will agree that we have come a long way in our surface protection techniques. With the great fund of knowledge that all of us can gain from the Alyeska project, I would hope for a leap forward in the near future on techniques which can be utilized in the many varied situations with which we must deal. We hope to use native species rather than exotics for a large part of our new effort, but we have a long way to go in that area. I envision a system whereby exotics that provide early protection will be replaced by native species as the best we can hope for in the immediate future.

In other areas of surface protection, I believe that we will be able to justify matting and insulation to replace gravel on many of our projects when true cost comparisons are made. This new trend will certainly have dramatic effect on any new major projects in the gravel-poor areas of the State. Here again, for future reference we are monitoring closely the efforts along the pipeline workpad on the use of insulation, but are relying upon Alyeska and the monitoring agencies to keep valuable data in selected areas.

Among the things I have learned from the North Slope haul road experience thus far is that one cannot be too careful in making cuts in the lips of stream terraces when transecting from the terrace to floodplain. If you are involved in the environmentally hazardous experience, keep plenty of insulating material close at hand. Another lesson is that sacrificing road alignment to maintain a cover on side hills and other areas where cuts are necessary is often the cheapest and best engineering solution. The problem of the designer is to adjust a safe alignment and maintain as much cover as possible. It will never be easy, but new techniques in using insulation and revegetation programs will make substantially easier in the future the problems of those who wish to construct roads in permafrost areas.

Surface Protection Aspects of Dams and Transmission Lines

J. G. Ebner

ABSTRACT
Dams and powerlines have common problems in terms of access management. In terms of surface disturbance resulting from construction, dams involve rather extensive surface change, including not only sizeable localized construction activity, but also the inundation of large areas of lands and streamflow regulation. By contrast powerlines are usually highly visible and, to many people, obtrusive; yet they involve a small degree of physical change of the environment. The potential of new access created by both types of projects is an important secondary effect, to be managed in accordance with the planned land use.

Alaska Power Administration operates and markets power from two hydroplants: Eklutna, near Anchorage, has been in operation for 20 years; and Snettisham, near Juneau, has been in operation only 2 years. In addition, we do development studies on other potential power sites throughout the State. Recently, we prepared the transmission study for the U. S. Army Corps of Engineers feasibility report on the Upper Susitna project.

Surface disturbances from a dam project and a transmission line project are quite different. For a dam project, construction is localized. It involves the excavation and transportation of massive amounts of material and the preemption of a large area for the reservoir. A transmission project, although ordinarily involving much less land than a dam project,

is more visible to the general public. Its linear nature can involve extensive surface transportation systems, with possible effects on public use of lands crossed by the line.

Dams

The focus of a dam project is the project site itself. Drawing material from surrounding borrow areas and importing vast amounts of material, a dam project requires the minimum number of roads radiating from the construction site to sources of materials. These roads must be designed to endure constant heavy vehicle traffic for several years. Some of these roads will be maintained as access roads after project completion; others will be shut down and revegetated. Failure of a road would entail not only environmental damage, but would result also in economic loss. Initial road design must recognize the requirements of soils and slopes in the project area to minimize road impacts.

Because of the major role of transported materials on dam construction, efficiency of transportation is important. The burden of surface protection is placed on road design rather than vehicle design so that relatively high loadings can be used.

As far as the reservoir is concerned, surface protection requires that the area be cleared before flooding and that unstable slopes along the reservoir margins be identified or at least earmarked for nondevelopment. The high heat capacity of a reservoir causes a recession of permafrost around the lake. Where applicable, this phenomenon, combined with the undercutting of slopes by shoreline erosion, may cause instability in presently stable slopes.

There is little or no wasting of slopes along the shorelines at our Eklutna and Snettisham reservoirs. At Snettisham, however, the water coming through the diversion tunnel used to temporarily lower the lake level, caused erosion of materials at the tunnel outlet. Although short-lived, this action produced a significant amount of deposition farther down the drainage.

At Silvis Lake project in Ketchikan, the failure of an undersized spillway during abnormally high lake levels caused the destruction of the spillway and powerhouse, as well as the denudation of the entire slope below the spillway.

The reservoir at Eklutna is relatively accessible to the Anchorage public and receives a lot of recreational use. Problems with this have been slight; some vandalism occurs, and the usual problem of litter is slight. Reservoirs can be expected to have a high recreational potential; long reservoirs extending up unnavigable rivers can create a water access corridor with attendant secondary impacts. Such might be the case along the Upper Susitna River.

Transmission Systems

A. Planning - To most people transmission systems are the most frequently noticed elements of the much larger total system of the power project. Much smaller in acreage and expense than dams and reservoirs, they are unique in that they cross much longer distances and many different ecosystems. Surface disturbance of these systems is relatively low compared to that from most projects of similar scope. Most objections to these lines stem from their visibility and additional access.

Since clearings and structures are involved, lines can be highly visible. The Eklutna lines within a few miles of the powerhouse are quite visible for some distance. Important factors affecting visibility are distance, which is also related to scale of towers to environment, and whether or not the clearing is on a slope. Clearings are much more visible on slopes than on level ground. On the Snettisham project, use of dulled conductors greatly reduced specular reflections; green anodized aluminum was used for towers. The color was a poor choice, but it showed that color can reduce visibility.

Continuous clearing and access road construction are the two phases of transmission line construction affecting historical, particularly archeological, sites. The best way to avoid disrupting these sites would be to conduct a survey to locate them before the final line location procedure. Once sites are located, avoidance is relatively easy. With aerial construction, the possibility of disturbing sites is much lower than with construction from surface access.

B. Construction - Disturbances associated with constructing a transmission line itself result from the placing of footings and from clearing. Footings are located at the rate of four or five per mile for a 230 kilovolt (kv) line, and vary from excavated concrete footings to frost screws, which are helical pilings such as those used on the Golden Valley Electric Association 138 kv line in Fairbanks. Disturbance is localized and the area could be rehabilitated by regrading and, if necessary, protecting it with mulch, and fertilizing and revegetating. Normally, the affected area is small and revegetation is not necessary. In permafrost soils and muskeg, to prevent possible future disturbance from settling and heaving, heat-transfer devices can be used to keep the foundations permanently frozen in place. These devices have been used successfully in other installations; for transmission structures, they have been tested successfully by the Golden Valley and Chugach Electric Associations.

Clearing can cause considerable soil disturbance. Fortunately, most sensitive soils do not support forests heavy enough to require extensive clearing; most clearing is done on soils that can tolerate the disturbance.

Clearing can be limited, reducing amount of damage and costing less than heavy clearing. A minimal clearing computer program was devised by Bonneville Power Administration and is now used extensively by them to

minimize clearing on new lines. In this program, aerial photography, a Kelsh plotter, and a digital computer terminal are used to identify the exact cutting boundaries on either side of the centerline and individual danger trees outside of the boundaries.

Fallen timber, if merchantable, can be removed for sale if an access road is used. Slash may be chipped to provide a ground cover for disturbed soils. Quite often, it may be necessary to burn slash to prevent fuel accumulation and outbreaks of forest-damaging insects which thrive in downed timber and slash.

In forests of medium to light density in Alaska, a common practice has been to clear areas by bulldozing trees. This is the most disturbing method of clearing; topsoil is disturbed not only as root wads are pulled, but also by the churning of treads or wheels. Bulldozing is acceptable only for road clearing, for which stumps usually need to be removed anyway. With this method of clearing, downed trees are pushed to the edge of the clearing for disposal. On slopes, this practice is particularly damaging, especially if the clearing takes a steep grade directly over hills. Without the stabilizing effect of roots, the soil is highly vulnerable to erosion.

For one method of construction, an access road would be used for all or part of the transmission length. This is often the best method where soils are suitable; access is easily maintained and reliable. Problems arise, however, on permafrost zones, frost-heaving soils, poor foundations such as muskeg, and on unstable slopes and at river crossings. Some of our Eklutna line has low standard access roads, and we have had few problems with them. Many different schemes of continuous or partial access road use are possible. Public use of access roads may cause problems in areas not served by other easy methods of surface access. Conflicts may arise with land-use policies of the land-managing agency.

All-terrain vehicle use is an alternative to the access road. ATV's are not as efficient as conventional vehicles on roads, however, and they are better suited for maintenance than for construction.

Winter construction along with summer use is an alternative where soils are poor. Snow cover must be sufficient to prevent damage to underlying vegetation. Vehicle track loadings are the pressure-on-soil function of vehicle weight and surface area of track or tires. They must be considered to avoid rutting and overcompaction of snow. Working conditions in winter are not ideal, and work may be limited to delivery of materials.

Helicopter construction often is used to avoid surface disruption. Negative aspects of this method are the greater expense, weight limitations, weather limitations, and potential safety hazards to persons working underneath helicopter delivering towers. The positive aspects are the minimization of ground contact, access to terrain that can't be reached

by other methods, and efficiency for tower erection and conductor stringing.

Helicopter construction was used on our Snettisham system for the entire overhead length. The scarcity of suitable flying weather in Southeast made this method somewhat unreliable, but helicopters enabled construction to continue over very rugged terrain.

C. Maintenance and Operation - For maintenance, a road is the most reliable access, allowing heavy machinery to be moved in quickly for repairs. Line patrols are easy and economical; vegetation maintenance is also easy. A road needs upkeep, however, and in areas not well suited for roads, maintenance problems may offset advantages. Roads are highly visible in nonforested terrain, particularly on slopes.

ORV maintenance is usually coupled with aerial inspection. ORV's allow modified maintenance vehicle access to many areas. ORV maintenance is best suited to low density forest and treeless areas, and is difficult in forested areas if brush has been allowed to grow back into clearings.

Impacts from ORV use vary with surface and vehicle characteristics. Minimum use is recommended to minimize disturbance. Any transmission design that reduces the need for ORV maintenance is desirable, since reliability reduces maintenance traffic.

Helicopter maintenance depends on weather, yet offers quick access and fast surveillance; patrol and repair needs are usually within weight limitations of the aircraft. Disturbance is minimal; only landing pads in forested areas need maintenance. Manual brush cutting is not as suitable as aerial application of herbicides with helicopter use.

A road affects accessibility in several ways. If a transmission corridor pioneers a new corridor with access road, the access road will attract use for recreation, hunting, prospecting, transportation, and other purposes. Ability of roads to absorb new traffic is relatively good. Ability of new terrain to absorb activity introduced by the road may not be good at all. An access road may act as staging point for ATV vehicles brought in by standard vehicles, greatly expanding their range of action. The surface may not be durable enough to stand this use.

Access policy is the responsibility of land-managing agencies, transmission designers, and the public. The land managing agency determines if an access road is allowable, and, if it is, what public access policy shall be. Engineers responsible for access road location and design standards should design roads to handle expected traffic without necessarily encouraging it. Public responsibility is to comply with the access policy set out by the operating agency and the land managing agency.

D. Underground Transmission - Although seemingly less disruptive of the environment, underground transmission actually is much more disruptive

than overhead, even if we disregard for the moment the additional costs and inefficiency of burying high-voltage transmission. Undergrounding requires a continuous disruption of the surface for its entire length, unlike an overhead system, which requires excavation at four or five locations per mile.

An ac underground system can have all three phases in one cable or pipe, requiring only one trench. The right-of-way needed is basically as wide as the trench, the construction road, and a buffer distance to the other side of the trench. An access road is required, so it causes impacts along with those from the trench excavation and backfill.

In operation, a transmission system generates heat in the conductors. In an overhead system, this heat is easily dispersed to the air; in an underground system, heat dispersal may cause problems, particularly in permafrost. This heat can result in settling of ice-rich soils and possible rupture of the cable. Generated heat can be dissipated in several ways. Normal installations are backfilled with "thermal sand" of higher heat transmission. Through ice-rich permafrost, heat dispersion into the soils would be discouraged. Heat-insulated cable could be used to retard heat flow into the surrounding soils, although the high cable temperatures would tax the capabilities of most cables. Oil-filled cables could use a circulating oil design to transfer heat from the cable. Heat transfer systems employing refrigerants could also be used. All would be considerably more expensive than cables with no exceptional heat dispersion requirements.

Several other environmental factors affecting underground transmission are frost heave in poorly drained soils, earthquakes, and mass wasting of soils. Although theoretically more reliable than overhead systems, underground systems are subject to different potential faults and practically, are more difficult to repair. A fault, once located, would entail the re-excavation, repair, and reburial of the affected section of cable. Soil disturbance will be equal to that from the original construction. Since machinery is required for these operations, either an access road must be maintained or ORV's are used.

Visual Resource Management

Stanley V. Specht

ABSTRACT
The American people are concerned about the quality of their visual environment. Whether they are in Alaska or the lower 48, their concerns and thoughts are readily apparent and often expressed. Because of this concern it has become appropriate to establish the visual landscape as a basic resource. This resource is one to be treated as an essential part of the land and receive equal consideration with the other basic resources.

The presentation addresses the effects of modification of the land's surface on the visual resource while the natural resource base is managed. A brief description of BLM's technique for identifying and managing visual resource values is presented, as well as how the system is used to predict potential impact from a proposed activity. Examples are described where surface disturbance affects the visual resource and how rehabilitation may lessen such impacts.

What is BLM's visual resource in Alaska? It is the land and water surface, the vegetation, and the structures on every acre of land. In the past, BLM and others have managed the forage, timber, wildlife, minerals, and other resources, sometimes at the expense of the visual resource.

Why do we need to manage visual resources? What makes it important?

People. Much of the land in Alaska is under the management of BLM. These lands can be viewed by the public from the State's limited highway and railroad systems or its extensive river network. The remainder can be seen by "The Great Land's" flying public. More and more people are beginning to use the public lands and more people are beginning to recognize the values of open public lands. They're also beginning to recognize when the management of these lands is less than what it could be.

What are the people that are using BLM lands doing out there? This is easy to explain, and I am sure most of you are aware of the answer. More people have more leisure time and are spending it on travel and outdoor recreation. When they're traveling, they're looking. In fact, sightseeing is a major part of almost all outdoor recreation activities.

What are people looking for? I think we might agree that most are looking for a change of environment. They're trying to get away from the hustle and bustle and the traffic and other people; they're looking for interest, variety, and beauty. They want a pleasant environment.

Can BLM provide that environment? The environment already exists. Our responsibility is to maintain its quality. We have the quality, the interest, variety, and beauty that people are seeking. But, how do we, as land managers, define beauty and relate it to land management?

The word beauty calls up all sorts of images--it means many things to many people. This statement pops up every time we try to relate beauty to land management: "Beauty is in the eye of the beholder." This may be a good time to try to explain why beauty is in the eye of the beholder and why it is important to us as land managers. The statement would be more accurate if it were changed to: "How beauty is perceived is in the eye of the beholder."

What one man sees from any one viewpoint is the same as what any other man sees. How he interprets what he sees is where the difference lies. Because past experience affects how a man perceives his environment, familiarity becomes a major factor in a person's interpretation of what he sees. People are more comfortable in familiar surroundings and may also be somewhat oblivious to them. Once they leave these surroundings, they become more acutely aware of what is happening around them. Something that may just fade into the background in a familiar area becomes a point of interest in a strange place.

When we try to define beauty, we get into some confusing terms. Interest, utility, and beauty are interrelated but not the same at all. A place may be interesting without being beautiful. Some may confuse utility or eventual utility with beauty. This is why the designer may see a pipeline under construction as a thing of beauty, or the engineer may see beauty in a well-constructed road even though it may virtually destroy the scenic value of an area. Special features like the largest, the most, and the unique take on a scenic value that some may relate to beauty. As you

see, defining beauty can be very difficult. Most people agree, however, that a natural environment contains a certain degree of beauty, some environments more than others. Nevertheless, nature has a way of providing a pleasant experience for the eye.

Most people are aware of this, and, in fact, have a preconceived impression of what they expect to see in a natural environment. They may develop a resentment toward any intrusions or abrupt changes in that environment.

The lands we in BLM manage are primarily in a natural or near-natural condition. This narrows the scope of what we are trying to define when we talk about beauty as it applies to land management or use. We are concerned with a primarily natural environment and we are trying to maintain a degree of that natural beauty and character.

Many of our land management practices have the capability to make significant intrusions on the character of the natural landscape.

The challenge, then, of visual resource management, is to recognize these potential impacts and design our land management practices to complement the natural character of the landscape rather than intrude upon it. Manmade changes do not necessarily need to be considered intrusions. It is only when these changes do not fit into the characteristic landscape that they become intrusions.

How can we make the necessary changes in the landscape without creating adverse visual impacts? To do this, we should understand a little more about how man perceives his environment.

Some researchers in perception estimate that man perceives his impression of the world around him as 1 percent by taste, 1-1/2 percent by touch, 3-1/2 percent by smell, 7 percent by hearing, and 87 percent by sight.

Eighty-seven percent of man's perception is based on sight. Human beings rely on sight more than on all their other senses combined. It is apparent that a good deal of concern should be placed on the visual qualities of our environment and how our management practices affect that quality.

How many effects of our management practices are tasted by our public? How many touched? Smelled? Or heard? That 87 percent becomes very significant, doesn't it? People recognize and react to the results of our management practices almost 100 percent by sight.

Whether or not you agree that the visual aspect of what we do is an additional resource, it's quite obvious that how we handle the resource is an extremely important part of the public acceptance of our programs.

Since enactment of the National Environmental Policy Act, public

acceptance can determine whether or not we even have a program. Many BLM managers have already begun to recognize the visual impacts of some of our practices and have made efforts to improve on them.

If we are to continue to manage the visual quality of the National Resource Lands, it is important that we all know more about what we call the visual resource.

What do people see on National Resource Lands? What types of what we might define as features do we see in typical scenes? The features we can identify are trees, shrubs, grass, rocks, soil, mountains, clouds, sky, snow, and buildings. If we place all of these features into categories, we find we have vegetation, land and water, structures, and climatic factors.

Since we are talking about management of the visual resource, we can limit discussion to the first three categories. Land and water surface, vegetation, and structures are the manageable visual resources. There is not much we can do about the climate.

Now we have answered the question, "What do people see?" The next question that arises is, "How do they see it?"

You've seen a log cabin. It's a part of your past experience; we talked about that earlier. But what is it that tells you that the image in your mind is a log cabin?

The form, color, texture, and outline or lines of the individual logs are the elements that define a particular building as a log cabin.

Form, line, color, and texture are the major elements that are perceived in any visual composition. These are the basic elements that define landscape character, and they are the major tools we can work with in management of visual resources.

Let's look at how we perceive the basic elements in a natural landscape.

1. Form is most strongly expressed in the shape of the land surface, usually the result of some type of weathering, glaciation, or earth movement. It may also be reflected in the shape of the openings or changes in vegetation.

2. Lines found in the natural landscape are the result of an abrupt contrast in form, color, or texture. Lines may be found as ridges, skylines, changes in vegetation types, and in individual trees and branches.

3. Color, as perceived in the landscape, is most prominent in the vegetation but may be noted in the soil, rocks, water, and may vary with the time of day, time of year, and with the weather.

4. <u>Texture</u> is the result of the size, shape, and placement of parts, their uniformity, and the distance from which they are being observed. Texture, as it is perceived in the landscape, is usually the result of the vegetation or vegetative patterns on the landscape. It may also be the result of the erosive patterns in rocks and soil, or as a combination.

Now we have defined what we see (features) and how we see (elements). How well we see is determined by the amount of contrast displayed in the basic elements. The amount of contrast we see in the basic elements is determined by a number of variables. Some of the most critical variables are distance, angle of observation, time of viewing, size or scale, light, and season of the year. Possibly the most important variable is distance. The closer you are to an object, the more distinct the contrast becomes.

Those are some of the tools we can use in defining the character of the landscape and how we can relate our management to it. We need a few more tools, however, to add to our kit. A scene may have form, line, texture, color, and contrast, but it may not be pleasant to look at. Something else is needed--variety.

Another scene may have variety but may be missing something else--harmony. We must have harmony, therefore, in a contrasting variety of basic elements in order to have a high-quality visual experience.

Let's review that just a bit. Form, line, color, and texture are the basic elements that define landscape character. The more variety and the stronger the contrast displayed in these basic elements, the more interest there is and the stronger the character is said to be. The degree of harmony among the basic elements determines whether or not a given landscape is pleasant to view. There are two points that we can make here:

1. A landscape that has a relatively weak character can provide a pleasant viewing experience if all of the basic elements are in harmony.

2. If the basic elements are not in harmony, the view will not be pleasant regardless of the strength of the character. A mining operation may be very interesting, but certainly not beautiful!

Many of our management practices make an impact on the visual resource. Reducing the visual impact with satisfactory results may cost more, but not necessarily so if we are equipped to apply a few design principles in the early planning stages.

Keep in mind that there are only three types of features in the visual resource--land and water surface, vegetation, and structures. The only way we can change landscape character, therefore, is to change one or more of those features. That simplifies the task somewhat, but almost everything we do changes one or more features. The methods we can use are to select location carefully, minimize the disturbance, and repeat the natural elements.

Careful location is probably the single most effective method of reducing visual impact. In many cases, proper location includes concealment. If no one can see a project, there is no need for other measures to be taken. All public lands are subject to view by some people at one time or another, however, so we do have to use some measures other than concealment to reduce impact.

When choosing the location for any type of project, we should take full advantage of any natural change in topography or vegetation. If a change must be made, it is less noticeable if it is made where a natural change already exists. For example, if we were to build a road down a valley, where would the best location be--at the toe of the slope or where the vegetation changes? We have two options. An alignment placed where there is a natural change in the vegetation reduces the visual impact.

The next method is to minimize the disturbance of the natural character as much as possible. As an example, at one time it was common practice to clear a straight, even line with a Caterpillar tractor when conducting seismic investigations. Today, however, technology allows moving equipment by hand or helicopter around obstacles, such as trees and lakes, with a minimum of disturbance.

The final method we can use to reduce impact is to repeat the basic elements that are displayed in the characteristic landscape (form, line, color, and texture) in a manner that will reduce the contrast created by the project. Manmade projects tend to contrast with the natural elements, and this contrast creates a focal point that draws the eye. Reducing the contrast is the key to remember when we are trying to reduce visual impact. If we can reduce the contrast in form, line, color, and texture, we can effectively reduce the visual impact of any land management activity.

Cultural Resource Protection

Gary Matlock

ABSTRACT
Legislation to protect historical and archeological resources in the United States is older than surface-protecting legislation. Since the 1906 Antiquities Act, stronger legislation has been passed that requires survey, inventory, evaluation, and mitigation procedures for cultural resource sites that may suffer impacts from earth-disturbing projects. Federal cultural resource specialists, State Historic Preservation Officers, and Native corporation staff members are familiar with programs for cultural resource protection. Project planners should contact their State Historic Preservation Officers early to include cultural resource identification and preservation in their planning.

Strong public and legal concern over the impact of surface-disturbing projects on both federal and other lands in the United States is largely a post-World War II phenomenon. Massive federal assessments in the form of Environmental Impact Statements (EIS's) and other documents may reasonably be dated to the passage of the National Environmental Policy Act of 1969 (NEPA), less than 10 years ago. While public concern for protection of "cultural resources" and the passage of the fundamental legislation for protection of those resources date from the late 1890's and early 1900's, it was not until the economic boom of the 1950's and 1960's that the public began to demand stronger legislation for the preservation of the Nation's cultural resources.

The first legislation to protect cultural resources in this country--the Antiquities Act--was passed in 1906. In nearly every decade since then, stronger legislation has been passed by Congress. The effect today is that all federal agencies must inventory, evaluate, and protect all significant historical and archeological resources that may be affected by any federal or federally funded, assisted, or licensed action. Most of you in this room have experienced the impact--both frustrating and satisfying--of this legislation.

The management of cultural resources is complex, and it is impossible for me today to discuss many parts of it in detail. I would like to discuss several aspects that pertain to this seminar topic. They include the following: 1. The direct and related legislation concerning protection and management of cultural resources at the federal level. It should be noted that most states, including Alaska, have similar legislation and the states are directly involved in the execution of some federal legislation; 2. The nature and some definitions of cultural resources; 3. Procedures for implementing legislation at the federal level; 4. Management of cultural resources on lands managed by the Bureau of Land Management; and 5. The role of the State in the protection of the resource.

The discussion is designed to help industry to anticipate the legal requirements and complete them with no interference with their work. We recommend that in any project planning, contact be made early with the Historic Preservation Officer for the State of Alaska and the cultural resource specialist for the agency concerned. The Bureau of Land Management, U. S. Fish and Wildlife Service, the U. S. Forest Service, and the National Park Service all have permanent archeologists and/or historians on their staffs in Alaska. Most of the Native corporations have individuals familiar with cultural resource programs.

"Cultural resources" is a term used almost universally by federal, state, and academic institutions to identify archeological and historical resources. While cultural resource programs include the disciplines of both history and archeology, differences remain between the needs of the two and the procedures for inventory, evaluation, and protection. The programs have in common management of the remains from man's past uses of the land, whether by European, aboriginal, or other peoples. Normally, the concern is directed to the physical remains left by earlier generations and those that have significance to us today or that will have significance in the future.

In some cases, however, events or people important to our past can be involved, although no physical remains are evident. An example is physical features that had religious significance or places where an important event occurred, such as the signing of a treaty.

While determining the significance of the site is the prime objecttive, all cultural resource activities must begin with survey and inventory, to identify archeological and historical sites for evaluation.

The sites are then evaluated in accordance with the 1966 Historic Preservation Act and appropriate mitigation determined before earth-disturbing projects begin.

Paramount to the consideration of the resource is its nature. Man's use of the land in the past has been extensive; in Alaska it has been more extensive than present land use would indicate. In other cases, selected areas have been used intensively. Quite often, in fact, intensive land use today for Native villages coincides with similar use in the past. Man tends to use similar reasons, whatever time period or whatever his cultural group, in the selection of areas for habitation and subsistence. In Alaska, the sites for modern Eskimo villages have been used for as long as 2,000 years.

Cultural resources, especially archeological sites, are highly sensitve to earth disturbance. If the past use of an archeological site is to be reconstructed, the site must remain undisturbed. Only on an undisturbed site can archeological workers separate the different levels of occupation and the tools and other artifacts associated with each succeeding use. The resource is irreplaceable, nonrenewable, and in many cases, quite fragile. It is also finite in quantity. Thus, most legislation for the protection of the resource is oriented toward identification so that the site may be evaluated for importance before it is destroyed.

Clearly inherent in this legislation is the fact that not all archeological and historical sites and structures have importance. Historical sites are sometimes easier than archeological sites to evaluate because of the methods used by the historian and the nature of the resources. It is not necessary, for instance, to save every gold miner's cabin in Alaska, but it must be determined which have importance as representative examples of an event, time period, or people.

Archeological sites are often difficult to evaluate in terms of the information they yield on the basis of surface indications alone. It often is necessary to excavate a site to determine its significance. Excavation is expensive, and it generally is preferable to leave a site untouched until excavation or testing are warranted.

The Cultural Resource Legislation

A list of the major cultural resource legislation at the federal level follows:

THE ANTIQUITIES ACT OF 1906 (34 Stat. 225)provided for the protection of historic or prehistoric remains, "or any antiquity," on federal lands; established criminal sanctions for unauthorized destruction or appropriation of antiquities; authorized the President to declare by proclamation National Monuments; and authorized the scientific investigation of antiquities on federal lands, subject to permit and regulations.

THE ACT OF AUGUST 25, 1916, establishing the National Park Service, provided for the conservation of "the scenery and the natural and historic objects and the wildlife therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." This indicated continued concern with the cultural environment.

THE HISTORIC SITES ACT OF 1935 (49 Stat. 666) authorized the programs that are known as the Historic American Buildings Survey, the Historic American Engineering Record, and the National Survey of Historic Sites and Buildings; authorized the establishment of national historic sites and otherwise authorized the preservation of properties of "national historical or archeological significance"; authorized the designation of national historic landmarks; established criminal sanctions for violation of regulations pursuant to the Act; authorized interagency, intergovernmental, and interdisciplinary efforts for the preservation of cultural resources; and other provisions. The first efforts to salvage data that would otherwise be lost were accomplished under the authorities of this Act beginning the RBS in 1946.

THE NATIONAL HISTORIC PRESERVATION ACT OF 1966(80 Stat. 915; U.S.C. 470) directed a national policy of historic preservation, including the encouragement of preservation on the state and private levels; directed the expansion of the National Register of Historic Places to include cultural resources of state and local as well as national significance; authorized matching federal grants to the states and the National Trust for Historic Preservation for the acquisition and rehabilitation of National Register properties; established the Advisory Council on Historic Preservation; provided certain procedures to be followed by federal agencies in the event of a proposal that might have an effect on National Register properties; defined the term "historic preservation" as the "protection, rehabilitation, restoration, and reconstruction of districts, sites, buildings, structures, and objects significant in American history, architecture, archeology, or culture."

THE NATIONAL ENVIRONMENTAL POLICY ACT OF 1969 (83 Stat. 852), among its numerous provisions, declared in Sec. 101-B(4) that it is the policy of the federal government to "preserve important historic, cultural, and natural aspects of our national heritage." In order to carry out this policy, the Act demands an interdisciplinary study of the impacts associated with federal programs.

EXECUTIVE ORDER 11593, "PROTECTION AND ENHANCEMENT OF THE CULTURAL ENVIRONMENT," May 13, 1971 (36 F. R. 8921). In reference to some of the above legislation, instructed all federal agencies to provide national leadership in historic preservation, to assure the preservation of cultural properties in federal ownership, and to "institute procedures to assure that federal plans and programs contribute to the preservation and enhancement of nonfederally owned sites, structures and objects of historical, architectural, or archeological significance."

THE ARCHEOLOGICAL AND HISTORICAL DATA CONSERVATION ACT OF 1974 (74 Stat. 220), the amended 1960 Reservoir Salvage Act, provided for the preservation of significant scientific, prehistorical, historical, or archeological data (including relics and specimens) that might be lost or destroyed as a result of 1.) the construction of dams, reservoirs, and attendant facilities and activities, or 2.) any alteration of the terrain caused as a result of any federal construction project or federally licensed project, activity, or program; provided that the Secretary will be notified of impending loss of such resources, and that the agency or the Secretary may survey and recover the data and publish the results; provides for agreement on time limits for initiation and completion of survey and recovery efforts; provides that the Secretary will coordinate, report on, consult with experts about, and distribute funds appropriated for, those survey and recovery efforts; provides that up to one percent of the total amount authorized to be appropriated for the federal activities may be transferred to the Secretary for implementation of the Act, and provides funds for certain other costs.

The legislation listed varies from simple to complex. The 1906 Antiquities Act states that sites of "antiquity" will be protected. Other congressional directives such as the 1966 Act, involve somewhat complicated and often lengthy procedures to be followed by federal agencies. Other Acts such as the Highway Act and the Reservoir Salvage Act are directed at specific earth-disturbing projects that will affect the work of only a portion of the members of the audience and with which they are undoubtedly familiar.

The most recent Act, the 1974 Archeological and Historical Preservation Act, defines clearly under what circumstances protection of the resource must take place. The Act states that any federally initiated, funded, or licensed project which causes "any alteration of the terrain" must contain measures for the inventory, recovery, preservation, or protection of affected cultural resources.

Muchof the legislation is oriented to federal agency management of cultural resources. The purpose of the seminar is specifically oriented to surface-disturbing projects and in the interest of time, I will not discuss other than the following aspects.

Procedures for Protection of the Resource

In the case of virtually every surface-disturbing project, two basic measures are necessary for compliance with federal legislation for protection of cultural resources.

First, acomplete survey must be made of the area to be disturbed to identify the existence of historic or archeological sites, if a survey has not already been made.

Second, measures must be taken to protect or mitigate the effect of the project on the resource. Measures may take a number of forms, depending on

the resource. This normally involves an evaluation of the importance of the individual sites. Proper mitigation is then either avoidance of the site, relocation of the project, or excavation of the site to salvage material and information contained in it.

Let me discuss these two basic actions in detail. A cultural resource survey must be conducted by a professionally competent individual, normally working under a valid Antiquity Act permit issued to him or her from the Department of the Interior as specified in the 1906 Act. There earth disturbance is anticipated, the survey must be a class III (100 percent) survey, designed to locate and record the sites. It is important that this survey be undertaken as early as possible in the planning of the project to enable compliance with the mitigation measures outlined below.

Alaska has a number of special problems in undertaking an archeological survey. Access is difficult in most parts of the state. Much of the state is covered with snow in winter and heavy mats of vegetation and is filled with vicious mosquitoes in the summer. In addition, fewer cultural surveys have been made here than in other parts of the United States.

Following the survey and its inventory, sites located must be evaluated for their eligibility for the National Register of Historic Places, their importance for scientific inquiry, or other characteristics. If the site is eligible for the National Register under the criteria identified in the 1966 Historic Preservation Act, impacts must not only be mitigated but certain review procedures must be instituted. These review procedures, or the document resulting for review, is called a Section 106 Statement. This statement, which is similar to a NEPA review document, must be prepared for any project which may have impacts on sites potentially eligible or already entered in the National Register of Histori Places. Preparation of the document assumes the existence of a detailed inventory of cultural resources in the proposed area of impact.

The 106(2b) Statement is submitted to the State Historic Preservation Officer. His staff usually includes an archeologist and an historian. They review the document for adequacy of inventory and proposed mitigation of impacts. After this review, the documents, with the State Historic Preservation Officer's comments, are forwarded to the President's Advisory Council on Historic Preservation. If all parties agree about mitigations, compliance with 36 CFR 800 is relatively simple. If not, the review can be time consuming and complicated.

It is well to begin these procedures early in any project. The inventory should be conducted as soon as the project area is clearly known. Then steps for compliance with 36 CFR 800 should be taken soon after. Early contact with the State Historic Preservation Officer for your state or with the agency involved is highly recommended. Consideration of the cultural resources is often overlooked in the planning process, only to cause delay and problems later.

Preservation and management of the historical and archeological resources has become a "given" by the American public. Much has been done by federal agencies in this area of cultural resources. Nevertheless, it is clear that much remains to be done before large portions of our Nation's history are forever lost. Fortunately, industry and government are of one mind on the pressing need to inventory, evaluate, and protect all significant historical and archeological resources. We can, therefore, hope that our Nation's past will be preserved, to instruct this generation and future generations as to where the Nation has been in the past and will be going in the future.

session five

CHAIRMAN: William H. Adams, Fire Management Officer
Division of Fire Control
Bureau of Land Management
Alaska State Office
Anchorage, Alaska

SURFACE DISTURBANCE--continued

Fire Control and Surface Disturbance Overview--BLM Responsibilities

William H. Adams

ABSTRACT

There is general consensus that wildfire has a natural role in the environment, but there is no agreement on the effect of fire on the natural resources. More research is needed. The Bureau of Land Management developed a classification system designed to assess the gross impact of wildfire on all the natural resources. The system was applied over Alaska to other agency administered lands, including National Resource lands. Wildfire causes direct resource loss as well as indirect impacts on the ecosystems. These impacts may be beneficial or detrimental, depending on the land manager's objectives. Several factors, most of them related to burn intensity, modify the impact of fire on resources. Good information on fire behavior and successional trends of vegetation is needed for the circumpolar region. Some work has been done in Canada and more is planned there and in Alaska. Heavy equipment, particularly bulldozers, does lasting damage to the environment. The damage is accelerated if the area is underlain by permafrost. Guidelines have been issued to minimize this damage. The Department of the Interior recently revised its wildland fire policies, and the BLM has developed guides to implement these policies on the ground. Two years' experience with these new policies has resulted in substantial savings with no appreciable increase in resource losses.

The Impact of Wildfire on the Environment

There is general consensus that wildfire has been important in shaping the vegetative mosaic of the taiga. Harold Lutz (1956) had this to say about forest fires in interior Alaska, "Their extensive and repeated occurrence in prehistoric, historic, and modern time is well substantiated."

While there is agreement that fire has had a natural role in the environment, there is not agreement as to the effect of fire on the natural resources.

Considerable research has been done on the effects of fire in the circumpolar regions of the world, but much of it has been narrow in scope. The thrust has been toward the effects of fire on a single resource rather than on ecosystems.

This deficiency has been recognized but has not been resolved. A fire-effects research study aimed at determining the net effect of wildfire on all the resources has been proposed. BLM and the U. S. Forest Service have agreed that such a study would reduce this knowledge gap. The results of the study (if it is implemented) will be useful in the long range, rather than immediately.

In the interim the Bureau of Land Management developed a classification system aimed toward determining the gross impact of wildfire on all of the natural resources. This system was applied over the State to other agency administered lands as well as to the National Resource lands. On a point system ranging from negative values to over 480, about one-half of the State was in Class I. Fire does relatively little damage to resources in Class I. A little less than half of the State fell into Class II, where fire does more damage to the resources. Less than 5 percent of the State fell into higher classes.

Here is a summary of the Bureau's fire-impact classification system:

1. An array of values was established for each natural resource to allow for flexibility when the system was applied to a specific site.

2. Local resource specialists then applied the system to all of Alaska. The point values assigned were arrived at subjectively and were based on available knowledge.

3. These point values may be altered as more or better fire effects data are forthcoming.

Wildfire causes some direct resource loss.

1. Wildfire nearly always kills black and white spruce because of

the thin layer of bark protecting the living tissue and because normal wildfire temperatures exceed the tolerance level of living vegetation.

2. Wildfire tends to increase heart rot in hardwoods which are not killed.

3. There is an immediate loss of wildlife browse and habitat.

4. Some forms of wildlife are destroyed.

5. Recreation values are generally decreased, as most of the general public does not find a black forest pleasing.

Wildfires cause indirect impacts on the ecosystem which may be beneficial or detrimental. For instance, the fire that kills spruce may accelerate browse reproduction which would make the land more valuable for some wildlife.

Several factors modify the impact of fire on the resources. Most of these are related to the intensity of the burn. They include:

1. Time of year.
2. Time of day.
3. Fuel moisture.
4. Days since precipitation.
5. Relative humidity.
6. Wind direction and speed.
7. Slope and aspect.
8. Size and distribution of fuel.

A forest fire may be a subsurface fire smoldering in the tundra; it may be flames a few inches high, creeping slowly along the surface; or it may be a forest fire (in the same forest) racing through the tree tops, creating its own winds, and destroying everything in its path.

A controlled burn in a black spruce stand similar to a black spruce ecosystem in Alaska was carried out by a Canadian researcher, A. D. Kiil (1972), in northcentral Alberta in July 1972. The purpose of the burn was twofold:

1. To determine fire behavior in that ecosystem.

2. To assess successional trends of vegetation on old burns in the

black spruce forest type.

The following were the immediate effects of the fire:

1. All of the aboveground plants and the top layer of the forest floor, including spruce trees, conifer reproduction, and Labrador tea, were killed.

2. The average scorch height was 9.5 feet and the maximum was 16.4 feet.

3. Fifty-four percent of the black spruce crowns were burned.

4. Depth of the burn was 3.2 inches and included all of the Cladonia. (Forest floor was 17.7 inches above the permafrost.)

5. The ground fire killed all trees, but none of the stems were consumed and the blackened stems will remain standing for many years.

6. Because the fire reduced the amount of available fuel, a disaster-type fire probably could not occur in the burn area within 25 years.

Some fire behavior data from the prescribed burn follow:

1. The forward rate of spread of the fire was about 21.6 feet per minute or 1/4 mph.

2. The forward rate of spread from spotting ahead because of a 12 mph wind was 196 feet or 2.2 mph.

3. Flame temperatures ranged from 1300 to 1800°F.

4. Head-fire flame length was 16.4 feet, and the depth of the flame front was 9.8 feet.

An indication of vegetative succession following wildfire on similar sites with deep accumulations of organic matter was obtained by on-site inspection of old burns and aerial reconnaissance in the study area. The following table is based on data from this inspection.

Projected Vegetative Cover

	Percent of Burn Area Covered by Four Categories			
	Pre-Burn	1972	1982	1992
No living vegetation	2	100	40	5
Labrador tea	90	0	75	85
Cladonia	50	0	5	35
Black spruce	20	0	2	10

While most fires in black spruce kill the aboveground vegetation, the reproductive characteristics of black spruce, Labrador tea, and other lesser vegetation favor a relatively rapid invasion and development of post-fire vegetation.

Impact of Suppression Actions on the Environment

Machines -- Generally heavy equipment, particularly bulldozers, does long-lasting damage to the environment. The damage by bulldozers is greatly accelerated when the area is underlain by permafrost.

Land managers are acutely aware of the potential for long-term damage through suppression actions. Generally, heavy equipment use is not authorized unless people and improvements are threatened.

Some other equipment, such as all-terrain vehicles, is used in suppression actions. The Bureau requires that these vehicles have an average footprint of less than 3.5 psi to minimize damage to the surface organic mat.

Fire Line Location -- Improper location of fire control lines has resulted in erosion and long-term environmental damage. The Bureau has developed guidelines on fire line construction and location to minimize these impacts. The use of natural barriers as control lines can help reduce damage.

Chemical Retardants -- It is recognized that most fire retardants used in Alaska are toxic to aquatic life if sufficiently concentrated. Guidelines direct how and when retardants may or may not be applied. The retardants commonly used in Alaska are fertilizers, and damage to the vegetation has not been observed.

Action Modification and Its Impact on the Environment

During periods of multiple-fire occurrence, action cannot be taken to suppress all fires because initial attack resources are committed. During these periods, priorities must be developed for which fires are to be actioned. The fire impact map is used to determine attack priorities. Fires on lands with high point values or high impact ratings receive action first.

Below are some conditions under which exceptions are made in the use of the fire impact classification system to set priorities.

1. Land use planning and management objectives exist for the land.

2. Agency land use objectives conflict. BLM protects other Interior agency lands to the same standards as for national resource lands. These other agencies are involved in assigning attack priorities when fires occur on their lands in multiple-occurrence periods.

3. Pressures occur from public opinion and awareness. The public often urges us to take action on a fire where attack was delayed because of low fire impact priority. A column of smoke visible from a community is often enough to trigger demands for suppression action.

4. Political considerations develop. A new potential administrator of lands may have single use objectives which call for alternative suppression actions.

5. Economic interests are affected. Smoke from forest fires often triggers requests for increased suppression actions from tourist-related industry or agencies. Another economic aspect is that trained Native crews comprise the bulk of our emergency firefighter force. These crews may ask for increased actions because of potential lost wages.

Most of these types of pressures were identified by an action modification system. Generally, it provides for the highest level of protection to areas with people and improvements. A corridor five miles wide on each side of public roads, communication lines, and energy related corridors has been established. A protective zone 10 miles in radius encircles each community. Larger cities have a protective circle 20 miles in radius.

BLM's Fire Control Policy

The Department of the Interior revised its wildland fire policy about a year ago. Here are some significant portions from it.

> "590.1.3A. Wildland fires whether on lands administered by the Department or adjacent thereto which threaten human life, man-made structures, or are determined to be a threat to the natural resources or facilities under the jurisdiction of the Department, shall be considered emergencies and their suppression given priority over normal Departmental programs. Bureaus will give the highest priority to preventing the disaster fire--the situation in which a wildfire causes damage of such magnitude as to impact management objectives and/or socio-economic conditions of an area.
>
> "590.1.3B. Within the framework of management objectives and plans, overall wildland fire damage shall be held to the minimum possible, giving full consideration to: (1) an aggressive fire prevention program; (2) the least expenditure of public funds for effective suppression; (3) the methods of suppression least damaging to resources and the environment; and (4) the integration of cooperative suppression actions by agencies of the department among themselves or with other qualified suppression organizations.
>
> "590.1.3C. Prescribed fires, which may include ignitions by natural causes, may be used to achieve agency land or resource management objectives under approved and coordinated plans."

The Bureau of Land Management gave additional direction, as shown in these excerpts from a BLM Manual Release 9210 dated 8/29/75:

"9210.1C. Managers must take action with adequate forces to contain all fires during the first burning period which occur on or are threatening the national resource lands. Fires occurring on lands identified for alternate suppression objectives, under paragraphs D and E below, must be attacked in accordance with alternate action plans. When multiple fires create a condition of insufficient forces, priority for action must be given the fires threatening the areas of highest value.

"9210.1D. Resource managers may use fire to meet specific resource management objectives in accordance with the terms of an approved prescribed fire plan. The plan may be implemented when (1) resource managers develop a specific resource management objective for burning; (2) the subactivity funds are available for carrying out the prescribed fire plan; (3) the burning conditions exist which are identified in the prescribed fire plan; and (4) the planned forces are available.

"Prescribed fire plans must contain the following minimal requirements: the objectives for burning; the fire behavioral and meteorological conditions which will accomplish the burning objectives; the pre-ignition action plan identifying fuels, preparation, burning sequence, fire breaks, and control force requirements for the planned action and for emergency fire suppression. An environmental analysis review is also required for each project. Prescribed fire plans must be approved by the State Director.

"9210.1E. In areas where the difficulty of controlling fires is extremely high and where the values threatened do not warrant the expenses associated with the usual initial attack procedures, managers may alter the suppression objectives contained in paragraph C by preparing special suppression plans. Areas having special suppression plans must be clearly defined on all initial attack maps. These plans shall include: Justification for the alternate initial attack method, fire behavioral and meteorological conditions under which the alternate action plans will be used, suppression action plans, an environmental analysis review, and an emergency suppression contingency plan. Such action plans must be coordinated with the resource managers and with all land owners adjacent to the area. Rehabilitation, if any, will be commensurate with the values and will be analyzed as part of the alternate fire suppression action plan. The State Director must approve all special fire suppression action plans."

BLM Alaska implemented these policies and made some interpretations which resulted in the following policies for Alaska:

1. Initially attack all fires limited only by available suppression capability and logistics problems.

2. Give first priority and adequate suppression capability to accomplish minimum loss on all fires which threaten life, property, and/or have high fire impact on the resource base.

3. Use the action modification and fire impact classifications, considering weather, to establish attack priorities when suppression capability becomes limited. Order additional capability.

4. On fires which escape initial attack and do not threaten life-property and/or have low fire impact the following policy applies:

a. Where control is feasible with modest suppression commitment, increase and sustain attack.

b. Where control is feasible only with massive suppression commitment, delay attack and develop an action plan commensurate with resource values at risk and fire impact.

Constraints to optimizing fire attack decisions include:

a. Incomplete land use plans and lack of land management objectives; or

b. Insufficient research information on fire impact relative to resources.

What do we use on interim basis for fire attack decisions?

a. Experience.

b. Existing studies.

c. Multi-disciplinary analysis of attack problems.

Present Status

1. Fire has played an important role in shaping the vegetative mosaic of the Alaska taiga.

2. There are not enough base data available as to the effect of fire on the natural resources. Short- and long-term fire effects research is needed.

3. Land managers cannot wait for these base data since they are faced with decision points every summer regarding wildfire. They must make fire attack decisions based on experience and the available knowledge of fire effects using a multi-disciplinary approach.

4. The fire impact overlay and the action modification overlay are the best available systems for helping management develop fire attack priorities.

5. The new Departmental wildland fire policies direct us to take action on all fires but also recognize that fire can be either destructive or beneficial. They also provide for the use of fire as a tool to achieve management objectives.

<u>Summary of Wildfire and Surface Disturbance in Alaska</u>

Wildfire does relatively little damage to soil and water of the Alaska taiga when compared to the effect of fire on the surface of lands in the Western United States. Our land does not suffer the massive mudslides, for instance, which often result from the removal of vegetation by fire in California.

Foresters in Alaska (Adams 1974) have speculated about the cause of the Great Kobuk Sand Dunes in the Kobuk River drainage and the Nogahagana Sand Dunes west of Huslia. Rowe and Scotter (1973) note there is evidence to indicate that similar dune-forming activity near Lake Athabasca in northwest Saskatchewan was caused by fire. Further research is needed to determine if fire is the cause of the dune activity in the Interior of Alaska. Fairly large areas of the Interior have fine sandy soil underlying the moss. It appears probable that repeated burns during abnormally dry years could destroy the moss cover and initiate the dune activity. If research can confirm this, a higher level of protection may be needed for these fragile areas. In addition, stabilization methods for these areas need to be worked out if dunes are encroaching on surrounding vegetation.

Occasionally, a severe fire in black spruce stands underlain by permafrost will result in slumping.

Studies (Viereck 1973) have been made on the effect of fire on permafrost. Viereck summarizes this work:

> "Fire in forest types underlain by permafrost results in a temporary thickening of the active layer. Although thawing in the burned stands the year of the fire may not be significantly more than in the unburned stands, by the end of the second summer it may be as much as 160 percent of that in the unburned stands. For the first 15 years after fire, thaw is more than 1 m; return to preburn thaw levels takes about 50 years.
>
> "One effect of the lowering of the permafrost table after fire is the formation of thermokarsts. In areas heavily underlain by ice wedges, thawing results in a subsidence of areas over the ice wedges, creating a polygonal mound and ditch pattern. The ditches or pits may be 2-3 m deep and often remain filled with water most

of the summer. Active thermokarst, with trees tipping into ditches and fresh cracks in the mounds, occurs in successional stands of birch at least 40-50 years after fire. Eventually, with the return of black spruce, these sites may become stabilized, or small thaw ponds may develop and continue in an active cycle of pond and black spruce as has been described by Druru."

Fire suppression activities in many cases have resulted in more surface disturbance than the wildfire itself. Management restricts the use of off-road vehicles for fire suppression and use of equipment is rarely authorized unless life and property are endangered. The impact of firefighters on the surface has also been recognized and all garbage and other materials brought into fire areas are removed.

The fragile characteristic of soils underlain by permafrost is recognized and guidelines have been written to reduce surface damage by fire suppression activity. There are also standard procedures to rehabilitate areas disturbed by fire suppression activities. Often, the rehab work is started while suppression activities are still under way to minimize surface disturbances which may result in accelerated erosion.

Finally, recent changes in our fire policies have resulted in input to fire decisions by resource managers. This, in turn, provides an opportunity to use fire as a management tool and to consider the natural role of fire in the Alaskan environment.

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Fire Control and Surface Disturbance
Overview--State Responsibilities

George K. Hollett

ABSTRACT
State Fire Law AS 41.15 defines responsibilities of the State, and in Section 41.65.020 is stated the role of the Commissioner of Natural Resources to protect forest lands by regulation. Formerly contracting with Bureau of Land Management for protection, the State now intends to provide fire protection on state and private lands along road systems. The terms fire control and fire management must be understood before sound decisions can be made. Fire and its role in the State must be placed in perspective with the economy, the ecosystem, and the management objectives of the State.

Statutes and Regulations

If one looks at the State Fire Law AS 41.15, there is not much question about what the State of Alaska responsibilities are. In Section 41.15.010, we find, "It is the intent of this chapter to provide protection to the timber resources and watersheds of all land in the State." Here then we have a pretty well laid out responsibility, but how we go about providing the protection is left up to regulation. This is found in Section 41.65.020, "The Commissioner shall, by regulation, make provision for the protection of forested lands in the State from fire and other destructive agents." To date, we have not put any regulations into effect.

The State's effort to meet its responsibilities has been done by entering into a contract with the Bureau of Land Management to provide the

necessary protection. The summer of 1976 will see the first change in our past direction as we put a state wildfire suppression force on the Kenai Peninsula. It is the intent of the State to move into fire protection of the state and private lands along the road systems within the next few years.

As we get into this new field, we will be looking to BLM, the U. S. Forest Service, and sessions like this to help us come up with workable regulations. The symposium held in Fairbanks in 1971, "Fire in the Northern Environment," and papers like that by Leslie A. Vierech, "Wildfire in the Taiga of Alaska," will also play a part.

Bill Adams has just given us an overview of BLM responsibilities in which he has covered BLM's fire control policy and its fire impact classification system. I am sure we in the state fire control organization will have to come up with something along these lines. One thing that must be kept in mind when we talk policy, is that we are dealing with private lands over many of which we do not have any direct control. A let-burn policy on state lands may not be acceptable to a private landowner. This type of situation, and economics as it relates to the cost of suppression, will play a big part in development of a state fire control policy.

Fire Control Versus Fire Management

Let's think about fire for a moment. I have used the term fire control as did Bill, but today we are hearing a new term--fire management. Anyone who has warmed his hands or enjoyed fire's friendly light knows that all fire is not bad. Fire, along with air, water, and earth, is a basic part of the environment. We do not judge air to be "bad" because of periodic, destructive hurricanes. We are drawn to water rather than avoiding it, despite its potential to cause devastating floods. We do not fear the earth, though we know that forces beyond our control can cause it to quake and slide.

Fire, no less than air and water, has been a natural directing force in the evolution of man and the earth he inhabits. Early in his history, man learned to use and control fire. It was, perhaps, his first tool. Yet, the acceptance of fire in the forest seems basically contrary to the beliefs of "modern" man. Perhaps we have progressed beyond the need for direct dependence on this natural force. Or maybe we simply do not know and understand it any longer.

Fire control consists primarily of firefighting techniques, firefighting equipment, and the necessity to get to the fire quickly so as to suppress it. Fire management is much more than fire control. It includes fire prevention--measures to be taken to lessen fire risk--as well as an understanding of fire ecology.

Russell Lebarron (1957) expressed the attitude that I believe is

shared among people working in fire management today, "We must find ways to prevent the wastefulness of wildfires, yet utilize the forces for good which fire possesses."

The notions that forest fires should be prevented and that those started should be suppressed as quickly as possible is being challenged today. The thrust of many current popular and some scientific articles is that fire is natural and, therefore, fire prevention and control are unnatural and, by implication, harmful to the "ecology."

The problem for forest land managers is that the public isn't able to discriminate between the selected situations when professionals may need to use fire for specific purposes and the general situation where wildfires are costly and harmful to people. This lack of distinction offers a real threat to the future effectiveness of forest fire prevention. To suggest that care with fire is unnecessary is, I believe, irresponsible and destructive. As I mentioned before, fire prevention is a part of fire management.

When deciding whether to attempt fire control in wild lands, managers must consider several factors. Not only must the economic value of the resources come under scrutiny, but also the probable effects and costs of suppression. Some of these effects were covered by Bill and others and will be covered by other speakers to follow, so I am not going to give you a long list. I do feel there is an urgent need to describe and quantify impact and effects of fire. The years ahead promise to be dedicated to halting and reversing the long decline in the quality of the American environment. Wildfire prevention and control as part of fire management will play an important part in this effort.

Fire and its role in Alaska must be placed in the proper perspective in terms of the economy, the ecosystem, and the management objectives of the State.

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Fire Access in the Alaskan Interior

Austin E. Helmers

ABSTRACT
Fire access usually should be via ridges, where soil tends to be shallow, erosion hazards minimal, and timber cover most open. Dry slopes with deep permafrost or none are useable, but any slope is a potential erosion hazard. Permafrost areas, muskegs, and poorly drained sites should be crossed only as a last resort, to avoid trafficability problems and long-lasting environmental damage. Access trails should be rehabilitated as needed. Pre-attack planning in zones accessible to ground vehicles will develop all facets of access so that information is available to dispatchers when needed. Cat bosses should air-check routes before taking off with equipment. An urgent need is for the development of low ground-pressure vehicles and aerial alternatives to dozers for fire suppression.

Whatever might be one's views on fire suppression, a higher quality land management is gaining momentum in Alaska. As resource management becomes more complex, environmental factors have to be defined more accurately in justifying management investments. Since fire is a major environmental factor, it follows that the management of fire must be an integral part of resource management. A recreation area, timber stand, or wildlife habitat cannot be managed effectively without effective fire management. Fire management affords an opportunity to reduce the cost and improve the quality of resource management.

The fire management aspect assigned to this paper is ground access, specifically by heavy crawler tractors, and in a zone of about 20 miles on each side of main roads.

The discussion also concerns what might be called secondary attack, the action taken when a fire escapes initial attack. Initial attack is often a combination of aerial retardant drops and jumpers. In the secondary attack, and under the present fire control methods, dozer use is a tactical possibility when resource or other values warrant.

What are some considerations in fire access involving dozers? Mostly I can only repeat well-known guides and offer a couple of possibilities for attack planning and methods that will reduce adverse impacts on the land. A good condensation of some guides is the report of a special committee assigned by the BLM State Director, Influence of Man-Caused Surface Disturbance in Permafrost Areas of Alaska (Martin et al. 1973).

There probably is good agreement that the basic critical factor in Interior fire access is that most of the area is characterized by continuous to discontinuous permafrost, with sporadic permafrost along the southern fringes. Consequently, the cat boss walking dozers to a fire should be familiar with appropriate guidelines:

1. Keep dozer routes to ridge tops and south-facing slopes. On ridges the soils tend to be thinner than elsewhere, and they are more stable due to increased amounts of rock in the profile or shallower depths to rock. South-facing slopes tend to be free from permafrost, or at least have only shallow permafrost tables. Even a dry south-facing slope, however, is an erosion hazard when the protective vegetation is disturbed. Many of the Interior soils contain a high fraction of silt-sized material. These soils are quite highly erodible. Thus, on steep slopes the route should dog-leg, or meander, to avoid long reaches where water tends to concentrate during intense rains or rapid snowmelt. The route should be cross-drained and stabilized as needed after use.

2. A corollary to the foregoing is to avoid permafrost areas. These tend to be, but are not restricted to, north-facing slopes and poorly drained lowlands. To cross such areas sometimes may be unavoidable. If so, it may be preferable to route dozers *en echelon* by two's or even singly, to avoid vegetation disturbance likely to result from a number in single file. The *en echelon* pattern will walk down more trees, but it could reduce mechanical damage to the insulating organic mat. The decision is up to a knowledgeable and watchful cat boss. Corrective follow-up action may be needed.

3. Use existing ORV routes where possible. Many ridges in the Interior have been traveled by various sorts of vehicles. These occasionally have sections of low trafficability, which, however, are seldom limiting factors to dozer access. But the cat boss should know about them and plan to avoid further site deterioration.

These are a few simple guides applicable to fire access in the Interior that are well-known to anyone familiar with cross-country travel there. An overriding guide is to know the environmental consequences of what we do, and to convey this understanding to equipment operators. For example, on the trail to a fire there should be few occasions justifying a D-8 spinning around on a locked track!

There are a couple of reasons why there should be diminishing needs for dozer trail guidelines. First is that there should be developed fire line construction techniques that avoid, or reduce, the use of dozers. There could be a virtual crash program to develop an effective low-ground-pressure-vehicle technology. Much could be applied from the mobility techniques of geophysical exploration. Such a program can be implemented through cooperative administrative studies involving fire control and resource management specialists, federal, state, and private.

A second development should be pre-attack planning. Like terrain guidelines, it is not something new. It is in use in some of the other states (USFS 1972). Early stages in pre-attack planning are in use by the BLM in Alaska; for example, fire impact rating.

Pre-attack planning should not be limited to fire access. But it is so limited in the present paper, and includes preplanning dozer routes and support factors on map and aerial photos, describing the factors, and storing the information for retrieval by fire dispatchers and tactical planners.

An attempt to illustrate pre-attack planning was done on a USGS 15-minute quadrangle (Fig. 1). This was a desk exercise only, and does not necessarily represent actual field conditions. Figure 1 shows a major road, the Elliott Highway. The legend shows that the highway and access roads to the pipe pad are trafficable for lowboys with dozers. It also shows places where lowboys can be unloaded. These are numbered T-1, T-2, etc. Roads that will support light trucks, typical of what would be used to haul fire suppression supplies, are shown, including sections of the pipeline work pad and older trails. Other sections of the pad and other older trails are mainly navigable by all-wheel drive and soft-tracked vehicles. The dashed single lines are the main point of the exercise, being the proposed routes for walking dozers to fires. Note that they generally are ridge routes. A special type of dozer access is the string of "plus" symbols, which are dozer-constructed firelines on previous fires. The rectangular boxes, numbered X-1, X-2, etc., are areas of probable trafficability problems on dozer access routes. Helispots are numbered H-1, H-2, etc. Special use or high value areas are hachured and numbered S-1 and S-2.

All of the features shown on the map would be put there only after being checked out in the field. There may be other helispots, lowboy unloading areas, or various kinds of trails, but they haven't been field checked. According to this proposal, the map would be accompanied by

PREATTACK PLAN

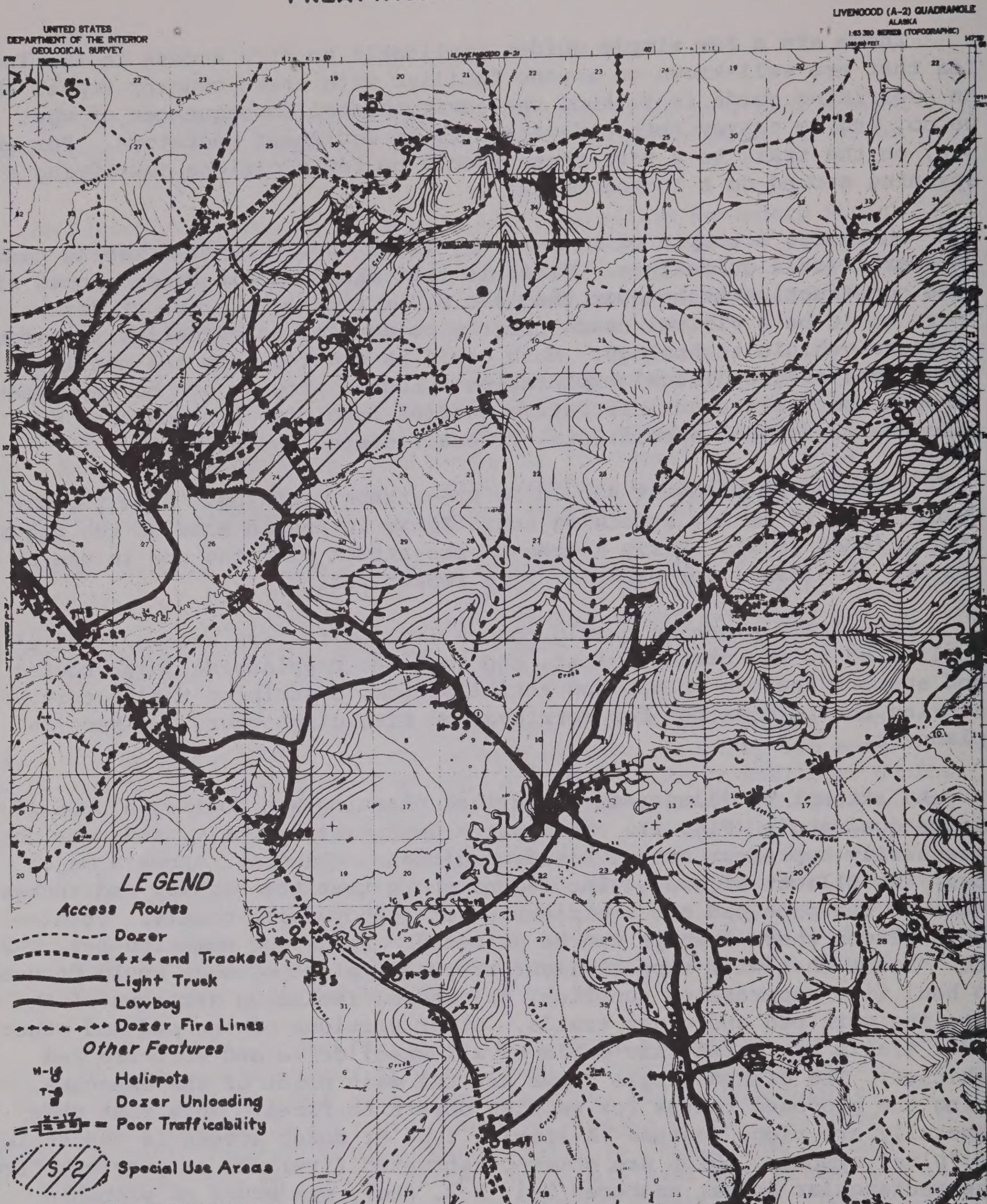

Fig. 1. Pre-attack plan on a USGS 15-minute quadrangle.

LO T3N R2W SW1/4NW1/4SE1/4 S 15 FBKS MER
DE SMALL ROCK QUARRY AT W END OF CHATANIKA RIVER BRIDGE. MEDIUM-ROCK BULKHEAD. HAZARD DUE TO OBSTRUCTION OF ONE LANE OF TRUCK TRAFFIC DURING UNLOADING. RAMP 12 PREFERABLE.
LS STATE DEPT HIGHWAYS. FF USE APPROVED, TROOPERS REQUEST NOTIFICATION PH 472-1116.
DA 8/15/75

14 NA TRACTOR RAMP - 15
LO T3N R1W CENTER OF S 28 FBKS MER
DE LARGE GRAVEL PIT, 2 RAMPS, BOTH WITH LARGE-ROCK BULKHEADS IN FAIR CONDITION. FAIR ENTRANCE AND EXIT FOR UP TO 5 LOWBOYS AT ONE TIME.
LS STATE DEPT HIGHWAYS. FF USE APPROVED, NO CONTACT REQUIRED.
DA 6/15/74 J. SMITH

15 NA TRAFFICABILITY PROBLEM X-14
LO T3N R1E S1/2SE1/4NE1/4 S 9 FBKS MER
DE OLD CHATANIKA RR GRADE, DENSE WILLOW AND ALDER. RUBY CREEK CROSSING NON-TRAFFICABLE FOR 500'. USEABLE ROUTE 1,000' UPSTREAM FROM GRADE, THROUGH DENSE BRUSH, THEN CROSS FIRM NARROW ROCKY FORD. NO GOOD CROSSING DOWNSTREAM.
LS F. E. CO. FF USE APPROVED, NO CONTACT REQUIRED, ADVISE OF USE SUBSEQUENTLY. JOE MINER PH 457-1999
DA 7/18/75 PHILIP WILLOW

16 NA TRAFFICABILITY PROBLEM X-15
LO T3N R1E SW1/4SE1/4SE1/4 S 8 FBKS MER
DE OLD CHATANIKA RR GRADE, DENSE WILLOW AND ALDER. BRIDGE GONE OVER DRAIN DITCH AND ADJACENT STREAM CHANNEL. TRAFFICABILITY DOUBTFUL. NO BETTER CROSSING UP OR DOWN STREAM. APPROX 30 MINUTES DOZER WORK TO CONSTRUCT A BRUSH RAMP.
LS BLM NECESSARY TO CLEAN UP CROSSING AFTER USE. SEE FBKS AREA MGR.
DA 7/18/75 PHILIP WILLOW

17 NA TRAFFICABILITY PROBLEM X - 16
LO T3N R1W NE1/4NW1/4SE1/4 S 18 FBKS MER
DE OLD CHATANIKA RR GRADE AT LITTLE ELDORADO CREEK. NON-TRAFFICABLE REACH ABOUT 700'. OLD DRAGLINE PROSPECT GRAVEL PILE 1,200' UPSTREAM ON S SIDE OF STREAM PROVIDES ENOUGH GRAVEL FOR TEMP CROSSING WHEN APPROACHED FROM W. FROM E NECESSARY TO CONSTRUCT A BRUSH AND TIMBER RAMP.
LS BLM CLEAN UP AFTER USE. SEE AREA MGR.
DA 7/18/75 PHILIP WILLOW

18 NA SPECIAL USE AREA S - 2
LO DRAINAGES OF CARIBOU AND POKER CREEKS
DE CARIBOU-POKER CREEKS RESEARCH WATERSHED. HIGH VALUE LONG-TERM MODERATELY INTENSIVE MULTI-AGENCY RESEARCH PROGRAM IN PROGRESS. NOTIFY DR. JOSEPH KLOTZ, INST OF NORTHERN FORESTRY, 479-7313 OR 479-6765, OR DR. C. W. SLAUGHTER, COLD REGIONS RESEARCH AND ENGINEERING LABORATORY 353-9102, OR 456-2259. THEY CAN PROVIDE PLANNING HELP IN AREA.
LS BLM AND STATE
DA 8/20/75 LEE WATERS

Fig. 2. Printout of part of the pre-attack planning information entered in the storage system.

FIG 3

PREATTACK PLAN -- HELMERS 01/27/76 2

6. HELISPOT - 37 T3N R1W SE1/4SE1/4NE1/4 S 15 FBKS MER APPROX TRIANGLE 500' ON EACH SIDE. FORMER GRAVEL STOCKPILE. SFC LEVEL. BARE FINE GRAVEL. COMPARATIVELY FREE OF DUST AND SAND. OBSTRUCTIONS = 20' GRAVEL STOCKPILE TO E. LARGE HELICOPTERS. ACCESSIBLE TO HEAVY TRUCKS. POSSIBLE RECREATIONAL BOAT TRAILERS IN AREA. STATE -- DEPT OF HIGHWAYS. FF USE APPROVED 5/21/74 J. DOE

7. HELISPOT - 38 T4N R1W NE1/4NE1/4SE1/4 S 35 FBKS MER CLEARED FIELD 1,000' SQUARE. COVER LIGHT GRASS. FALLOW FOR 2 YRS. OBSTRUCTIONS = NONE. SLOPE 7 DEG TO SE. APPROACH FROM DOWN VALLEY. ACCESSIBLE TO LIGHT TRUCKS. OCCUPIED CABIN AT SE CORNER OF FIELD. ELEV 950'. MARVIN SETTLER. NO PHONE. CONTACT VIA RADIOPHONE CALL 466-1313. ASK FOR UNIT 1137. 5/15/75 J. SMITH

8. HELISPOT - 39 T4N R1E SE1/4NW1/4SE1/4 S 31 FBKS MER HAYSTACK MTN. OPEN SUBALPINE TUNDRA. COVER UP TO 2' HIGH BRUSH IN DEPRESSIONS. SLOPE UP TO 10 DEG TO W. SFC MODERATELY ROUGH. CLEAR APPROACH FROM N. S. W. LIGHT AND MEDIUM HELICOPTERS. ELEV 2,400'. BLM 7/24/72 HOWARD JONES

11. TRACTOR RAMP - 11 T3N R1W NE1/4SE1/4NW1/4 S 2 FBKS MER A SAWDUST PILE ON JUNCTION OF TWO SINGLE-TRACK ROADS. CONSIDER RAMP FEASIBLE FOR ONE LOWBOY ONLY. AND THEN ONLY IF PILOT VEHICLE MAKES SURE ROUTE IS CLEAR. FOR MORE THAN ONE LOWBOY. RAMP - 12 IS BETTER. ROAD PRIVATELY BUILT BY SEVERAL HOMESTEADERS ON ROUTE. FF USE APPROVED BUT SHOULD CONTACT MARVIN SETTLER. NO PHONE. CONTACT VIA RADIOPHONE. CALL 466-1313. ASK FOR UNIT 1137. 5/15/75 J. SMITH

12. TRACTOR RAMP - 12 T3N R1W NW1/4NW1/4SW1/4 S 14 FBKS MER GRAVEL PIT RAMP USED ANNUALLY IN RECENT YEARS. LOG BUNKHEAD IN GOOD CONDITION. TWO-WAY ENTRANCE AND EXIT TO AREA. SUITABLE FOR LOWBOY CONVOYS. STATE DEPT HIGHWAYS. FF USE APPROVED. CHECK WITH J. A. RHOADES PH 479-8219. 6/15/74 J. SMITH

13. TRACTOR RAMP - 12A T3N R2W SW1/4NW1/4SE1/4 S 15 FBKS MER SMALL ROCK QUARRY AT W END OF CHATANIKA RIVER BRIDGE. MEDIUM-ROCK BULKHEAD. HAZARD DUE TO OBSTRUCTION OF ONE LANE OF TRUCK TRAFFIC DURING UNLOADING. RAMP 12 PREFERABLE. STATE DEPT HIGHWAYS. FF USE APPROVED. TROOPERS

Fig. 3. Printout of part of pre-attack planning information retrieved from storage system.

vertical and oblique aerial photos on which these same access features are marked.

In this exercise, the descriptions of helispots, dozer unloading spots, trafficability problems, and special-use areas were stored in a computer. Figure 2 is a copy of part of the stored information as printed out at the time it was entered into the storage system.

Let's suppose a fire in the area of Glacier Creek headwaters south of Haystack Mountain escaped initial attack and the decision is to walk in three dozers via Haystack Mountain and three via the old railroad grade out of Olnes. The dispatcher used his computer terminal to ask data storage "What have you got on helispots 37, 38, 39, tractor ramps 11, 12, 12A, and 15, trafficability problems X-15 and X-16, and special use area S-2?" Figure 3 is part of the printout that came back in real time. On the basis of pre-attack planning, a decision might be to offload dozers at tractor-unloading ramp T-12. As the lowboys are en route from base, the cat bosses check out the cat trails via helicopter and join the convoy at helispot 37, near ramp T-12.

Obviously, pre-attack planning should be much more comprehensive than for dozer access alone. For example, the plan should include hand line locations, barriers to surface travel, such as bluffs, fire and spike camp locations, water sources for pumpers and helicopter hoverfill, staging areas, boat landings, airstrips, etc. Locations of manpower and equipment such as for highway, pipeline, and other construction camps could be shown and kept updated in computer storage. A good plan should also show where various additional facilities are needed. Then, as opportunities arise there could be constructed additional lowboy ramps, new helispots, fuel breaks, etc. Perhaps some drainage or restoration would improve trafficability problems on access routes.

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Fire Control and Surface Disturbance All-Terrain Vehicle (ATV) Program in the Anchorage District

Les Rosenkrance

ABSTRACT

BLM Fire Control has been using ATV's in fire-suppression operations for several years. Several different types of machines were tested and used on a trial basis.

In the Anchorage District, ATV's are used as initial attack units. Mounted on flatbed trucks, they can be used as roadside tankers or be offloaded to pursue a wildland fire into dense brush or swamps. On occasion, they have been taken into interior Alaska and used on large fires. ATV's can be utilized in the control of wildland fires with a minimum of negative environmental impacts.

Fire Control and Surface Disturbance
Fireline Construction

Larry Knapman

ABSTRACT
Firelines, especially those constructed with heavy equipment, have been identified as one of the most destructive elements of fire in Alaska. Frequently, the effects of line construction are more damaging to the ecosystems than the fire itself. Using slides[1] and narration, this presentation covers fireline location, hand and mechanical line construction, damage prevention, and stabilization of lines.

This is a subject everyone is an expert on, but unfortunately the experts don't always agree.

As mentioned previously, wildfire does relatively little damage to soil and water in the Alaskan taiga when compared to the effects of fire on lands in the western states of the lower 48. Usually, the greatest damage comes from man's suppression efforts. This can be minimized with proper control line planning and construction and by controlling the use of heavy equipment (bulldozers and skidders) and other ATV's.

Keep in mind that what I'm about to tell you is not possible to do in

[1]Because of printing limitations, color slides used by Mr. Knapman in his seminar presentation are not reproduced here.

every case, and there are exceptions to every rule. Also remember while viewing the slides that these are not ideal situations but are used to illustrate a specific point.

Fireline Planning

There are some basic factors to consider in fireline planning.

1. Type of line constructed depends on the type of fire and values involved.

2. When possible, avoid obvious or suspected permafrost areas and other delicate earth materials. These may be detected by presence of some vegetation types, such as stunted spruce, or by cutting through the insulating mat with shovel or pulaski to see what is under it. Neither method is foolproof, since the frost surface may be a foot or two below the soil surface. You may also find frost in areas where vegetation does not indicate it.

3. Avoid north slopes. These are more likely than other sites to have permafrost, and even if they don't, disturbances take longer to heal because colder soil temperatures result in slower vegetative growth.

4. The line planner should fly the proposed lines, preferably with a helicopter so he can spot potential trouble spots and fully utilize natural barriers such as rivers, lakes, and bare ridgetops.

5. Use ridgetops for lines when possible. Ridgetop soils usually are better drained. Ridgetops may be devoid of vegetation or at least have such a small amount that very little clearing is required. If you build a line across the slope, do it on the contour.

6. Plan in water control. This helps in case you have melting frost or rainfall. Water control can be accomplished by cutting water dips with an angled blade, and by putting a small dogleg or offset to the high side of the mineral strip.

7. Avoid right angles in the line. The right angle turn will get rid of the water but creates problems with holding the fire because of concentrated heat.

Keeping in mind that the firelines may last much longer than the effects of the fire, plan lines to be simple and let your major concern be minimizing damage rather than reducing acres burned. In planning, allow yourself enough time to finish the line before the fire gets there.

Line Construction

A general rule of thumb is to disturb no more vegetation mat than necessary.

Handlines -- Assuming you're not taking direct attack, build handlines according to previously mentioned factors. A 2-foot wide trench through the vegetation mat to mineral soil is usually adequate. This should be backed up by a strip cleared of brush and trees, at least as wide as the tallest trees which might fall across it. Material from the cleared strip should be thrown on the side of the line away from the fire. This reduces the amount of fuel burning against the line and puts the fire on the ground. Be aware that this material can also restrict the escape route and hamper hotspotting, so be careful how it is placed. If you are burning out, you may pile cleared material on the fire side to have additional fuel for getting a start.

Catlines -- As previously mentioned, catlines are frequently the most destructive element of fire suppression in Alaska, both esthetically and because they damage soil and water resources. For these reasons, we seldom use them. Fires that burned many years ago have pretty well healed, except for the catlines, which in a number of cases have formed gullies.

Generally, one blade width to mineral soil and several of walkdown are sufficient. Walkdown, by the way, is a strip over which the cats have been walked with the blades about 1 to 2 feet above ground level, knocking the vegetation over, but not plowing up a continuous strip of vegetation mat.

When approaching a stream crossing, it is best to lift the dozer blades 100 to 300 feet before reaching the stream. Studies have indicated that approximately 300 feet of undisturbed vegetative mat will usually filter out most of the waterborne sediments from the line. The distance left undisturbed depends upon the slope and density and type of vegetation. Walkdown may be continued almost to the creek. Hand clearing may be required to improve the line. Equipment crossings should be upstream and angled so water from the line will not be channeled off the line in the vehicle tracks, thence into the stream.

Sloping stretches of line more than 100 yards long should have water control such as water bars or ditches angled to divert water off the line into undisturbed vegetation. This varies with slope, exposure, and soil type. Bars should not be constructed with burnable material such as vegetative mat unless the fire is out in that area and chances of a reburn are minimal.

Another possible form of water control is putting a dogleg in the "mineral soil" strip so that runoff water will be turned on to undisturbed vegetation.

Keep ATV's off the mineral strip; run them in the walkdown.

Helispots -- I would like to deviate a moment from firelines and mention something which frequently may be built during fireline construc-

tion, helispots! These can be easily and rapidly cleared with bulldozers, taking only a few minutes from line construction. Unfortunately, not enough thought is given to the damage which could occur.

With frost melting and a little rain, the helispot can become a sticky, unusable mess. On dry soils, very dusty, dangerous conditions can result. Construction of helispots like these also creates a problem during fireline reclamation.

Helicopter managers generally prefer a vegetated spot cleared by hand of brush and trees to a diameter at least twice the main rotor length. A log pad may be built if necessary. Avoid scraping off all vegetation. Dozer-built helispots are frequently made larger than necessary.

Other Methods of Line Construction -- There is a need for alternative methods of line construction, particularly those which minimize surface disturbance. Aerial application of fire retardant chemicals has been used with considerable success, and the retardant can be applied accurately and rapidly. The major drawbacks are the high cost of application and the round-trip time between loads.

Another possibility involves the use of large all-terrain vehicles, equipped with tank and spray booms which could lay retardant lines on a one-pass basis without being preceded by cats. The machine should be large enough to walk down big trees (4 to 6 inches diameter and 30 feet tall), yet have a light ground pressure when loaded. High cost is a drawback. For example, the Draggin-wagon costs $300,000 equipped.

Fireline Reclamation

I have stressed water control during line construction to reduce the efforts required to reclaim firelines. Having built your fireline on a good stable route, free from permafrost and on a ridge or on the contour with built-in water control, you must consider several more items to avoid serious disruption of the ecosystem.

As soon as a section of line is sufficiently under control or to the point where there is no danger of losing the line, reclamation of the "mineral soil" strip should begin. In some circumstances, there may be enough seasonal frost to cause mudflows or slumps in fine-particle earth materials, especially if you were fortunate enough to have rain help you stop the fire.

The first job is to apply more water control. Water bars may be built with berm material, the vegetative material originally taken off the lines. These should be built at an angle to turn the water off the line.

Another possibility is to push the berm material back on the line.

Spread it over the mineral strip if conditions are dry enough. Otherwise, you may have to settle for pushing it back in clumps and making frequent bars.

If needed, seed and fertilize for visual resource management or erosion control. Don't do it just because you have heard it's the thing to do. In many cases, fertilizing alone will do the job.

A couple of little tips: If you use supercharged D-8's and D-9's to build lines, tell the operators before they start that you intend to push the material back on the lines. The way they push it off makes a difference. If you use D-8's and D-9's to build lines, don't keep D-5's and D-6's to do the reclamation work. They are less expensive, but they can't easily tear apart berm piles that the big cats built. They may do additional damage to the vegetation mat next to the line while trying.

On steep, very muddy lines with mud flows, possibly on melting permafrost, a good method is to place berm material by hand. This results in very good ground coverage on an area that would have been more severely damaged by heavy equipment.

session six

CHAIRMAN: John L. Hall,
Director of Technical Services
Federal-State Land Use Planning Commission for Alaska
Anchorage, Alaska

SURFACE PROTECTION

Agency Policy and Procedures; Corporation Policy and Procedures

--continued on next page.

Policy and Procedures on Surface Protection
Bureau of Land Management

Richard W. Tindall

ABSTRACT
Bureau of Land Management surface protection policy has dual-purpose goals: (1) to protect the land and (2) to manage its resources. Federal laws under which BLM must operate are inadequate, antiquated, and often ambiguous. BLM procedures for preventing surface disturbance include field examination, development of stipulations, and compliance checks. Enforcement authority is found in three laws, each specifying a type of area. ORV regulations now are being revised. A strong Organic Act is needed, however, if BLM is to provide the best protection and management of the nation's public land and resources.

Bureau of Land Management policy for surface protection has two goals:

First, to protect the lands and environment from avoidable deterioration and correct past abuses;

Second, to manage, develop, and dispose of public lands while maintaining the quality of the environment, meeting people's need for land and resources, and contributing to the stability and growth of dependent users, industries, communities, and regions.

To do our job, we must contend with many inadequate, antiquated, and often ambiguous federal land laws.

For example, there are no surface protection restrictions in the mining laws, and on the other hand there are surface protection stipulations which we prepare on a case-by-case basis for permits, leases, and sales.

In addition, actions under the Mining Law of 1872 are nondiscretionary and the National Environmental Policy Act (NEPA) does not apply.

In one of Jack Turner's slides yesterday, we saw an area where the pipeline company was restrained from further use of vehicles in an area, but mining vehicles, utilizing the miners' right of passage, plowed on. Obviously, there is a double standard, a situation almost impossible to explain to company stockholders.

Procedures for Preventing Surface Disturbance

Public land-use actions originate from two sources--first, the uses desired by individuals and industry and second, BLM's own needs for construction, management, and other responsibilities. Basically, BLM procedures for both types of uses are the same:

1. A field examination is made of the area to be affected by the action. Normally, the examination is made by resource personnel.

2. An Environmental Assessment Record is prepared by an interdisciplinary team.

3. Surface protection stipulations are developed.

4. The action is either approved or denied.

5. Except for public agencies, a performance bond is required.

6. Inspection or compliance checks are made.

BLM was taken to court on its ORV regulations in 1974 by the National Wildlife Federation. The contention basically was that the regulations did not meet the intent of Executive Order 11644, which established criteria for designating restricted and closed areas, but the regulations provided that all public lands not so designated remain open to off-road vehicle use.

The court held that the regulations were invalid, and proposed amended ORV regulations came out to the field in 1975 for review. District recommendations were completed on November 5, 1975. Among other things, we at the District recommended that regulations be cited under the 2000 series of the Code of Federal Regulations (Land Resource Management, General) rather than under the 6000 series (Outdoor Recreation and Wildlife Management). At present, BLM has the authority under 43 CFR 6010.3-6010.5 to close land temporarily and establish rules for surface protection.

Campbell Tract and Tangle Lakes Archeological District

Now I'd like to discuss some specific areas managed by BLM-Anchorage District. The first is the Campbell Tract, which consists of 5,000 acres within the municipal limits of Anchorage. It was withdrawn during World War II by the military, returned to BLM in 1971, and is still under BLM jurisdiction. Because it is within the city, it is a popular recreation area for Anchorage residents. Along with a tremendous amount of public interest in the land, a great many conflicting uses have become evident, in both summer and winter. BLM has prepared rules of use for both seasons. These rules limit ORV use to designated roads and trails in order to resolve conflicts inherent among dog mushers, cross-country skiers, motor mushers, and others who use the tract.

Another area under BLM management is the Tangle Lakes Archeological District. This includes 460,000 acres that extend from Paxson Lake on the east along the Denali Highway to the Maclaren River. It is a designated archeological area because of archeological finds there. ORV use in the area has been increasing every year. The most preferred ORV routes are along ridges, and that is also where the archeological sites are located. So a conflict has arisen. In order to protect these archeological resources, a Surface Protection Plan has been developed for the District. The district manager has adopted almost all of the recommendations of the resource area manager. Here are the recommendations and a timetable for their use:

As soon as possible
Establish an advisory group of archeologists.

May 1976
Develop an ORV management plan, based if possible on new ORV regulations.

June 1976
Construct necessary ORV trail signs.

Summer 1976
Inventory archeological sites to determine size of archeological district necessary to protect them.

Fall 1976
Reduce size of archeological district if site inventory indicates need. (Man months necessary for satisfactory inventory can best be estimated by an archeologist.)

Winter 1976
Hold hearings on proposed ORV regulations for this area.

June 1977
Implement ORV regulations for this area. Need two seasonal recrea-

tion technicians or archeological aides to implement regulations and interpret the value of regulations to land users--June through October, 10 man months.

BLM Enforcement

Turning now to BLM enforcement, we find that authority is under the following laws:

1. PL 92-145--The Wild Horse and Burro Act of 1971. (You can imagine how much application this act has in Alaska.)

2. PL 93-303--Land and Water Conservation Fund Act of 1965. This act applies to a specific type of area--the Golden Eagle passport area--and only to lands within that type of recreation area.

3. PL 93-452--The Sykes Act of 1968. Under Title II of this act, designated BLM personnel would have law enforcement authority to deal directly with protection, but only in a project area developed by Sykes Act funds. Our BLM Director, Curt Berklund, feels that this is "BLM's Organic Act for Wildlife."

The longer I work for the Bureau, the more confused I get, but one thing I know for sure: To best protect and manage our nation's public land and resources, BLM needs a stronger Organic Act.

Policy and Procedures on Surface Protection Fish and Wildlife Service

David L. Spencer

ABSTRACT
The U. S. Fish and Wildlife Service has responsibilities for surface protection on National Wildlife Refuges and other federal lands. Refuge management responsibility is derived from several congressional directives, and its primary objectives are the protection of wildlife habitat and restoration and enhancement of the natural scene. The National Environmental Policy Act prescribes some considerations for management operations and proposed uses. Much of the U. S. Fish and Wildlife Service work related to surface protection on other federal lands is advisory and consists of reviewing proposed uses and making recommendations. This responsibility also is in response to congressional directives.

The United States Fish and Wildlife Service has responsibilities for surface protection of public lands in two general areas: lands under the jurisdiction of the Fish and Wildlife Service, i.e., National Wildlife Refuges; and other federal lands. I will discuss both of these.

The National Wildlife Refuge System is composed of more than 350 units distributed throughout the United States and comprising some 30 million acres. The mission of this system is to provide, manage, and protect a national network of lands and waters sufficient to meet people's needs for areas where wildlife is protected and made available to the public for observation and limited use.

The system is represented in Alaska by 18 units, comprising about 20 million acres. These range in size from the 65-acre St. Lazaria Refuge to the Arctic National Wildlife Range of 9 million acres and are located from Southeast Alaska to the Arctic Coast and the end of the Aleutian Island Chain.

Our National Refuges are multiple value areas that provide a wide spectrum of public benefits, ranging from such things as watershed protection and public recreation areas to salmon spawning grounds that support the commercial fishing industry.

National Refuges are not multiple use areas, however, in the popular sense of accommodating all conceivable uses on a piece of public land. All management is directed primarily to the welfare of wildlife and its habitat. All other uses, although frequently compatible with wildlife objectives, occupy a secondary position in formation of management decision.

As are other federal lands, National Wildlife Refuges are managed under a number of congressional directives. Those specifically aimed at protection of habitat and surface resources include the following: The Antiquities Act, the Refuge Recreation Act, the Wilderness Act, the Department of Transportation Act, the National Historic Preservation Act, the Mineral Leasing Act, the National Environmental Policy Act, the Endangered Species Act, the Refuge Rights-of-Way Act, and the National Wildlife Refuge System Administration Act of 1966, which is the present Organic Act for the system.

Although we may wish for more specific guidance, we find that these directives say such things as:

"Stresses preservation of the ecosystem upon which endangered species depend."

"Special effort should be made to preserve the natural beauty of wildlife and waterfowl refuges."

"Agency head shall issue stipulations to prevent damage to wildlife habitat."

"No person shall knowingly disturb . . . any natural growth."

"Permit the use of any area whenever he (the Secretary) determines that such uses are compatible with the major purposes for which such areas were established."

"Requires the exploration of all possible alternatives to habitat disturbance."

"Require an examination of environmental impact."

"Authorizes acquisition of land adjacent to refuges for recreational development to protect natural resources of refuges."

Refuge management policy derives from these directives and essentially stresses as primary objectives the protection of wildlife habitat and the restoration and enhancement of the natural scene.

All management operations and proposed uses are viewed within this framework and considered in ways now prescribed by the National Environmental Policy Act. Those uses or purposes that conflict with the primary objectives of wildlife and habitat protection may not be approved. This is the policy that basically guides our operations.

The policy rests on a series of regulations in Title 50 of the Code of Federal Regulations. The regulations generally prohibit many activities on National Refuges unless the activities are specifically authorized after full consideration of their impact on refuge objectives. Any permit or plan that survives this screening process is then fully armed with stipulations to protect the refuge habitat from damage. The authority to monitor uses, to enforce regulation, and otherwise to control all operations is delegated to the man in the field--the refuge manager.

We know that the best-laid plans of mice and men do not always work out. So it is with plans for the surface protection of National Wildlife Refuges. Other things intervene, and one need not go far to observe surface damage.

At one extreme we may note that Japanese military forces occupied the Aleutian Island National Wildlife Refuge in 1942 and set about massive surface disturbance. Although Refuge Manager Frank Beals had the aid of our National military establishment in correcting this problem, the whole thing shortly got entirely out of hand. Among other things, widespread surface damage resulted and has not been corrected to this day.

Other national interests sometimes override refuge interests. Examples are the development of oil resources on the Kenai National Moose Range and the testing of atomic devices on the Aleutian Island National Wildlife Refuge. When these events are authorized at higher levels of government, we take all available means to monitor the use closely and to prevent damage and repair surface disturbance as much as possible. The Atomic Energy sites on Amchitka are a good recent example. Although effort was made to minimize surface damage, extensive areas were physically altered and reduced to barren waste. After the testing, a large-scale and costly rehabilitation program was begun. Much of the damaged surface has been restored to some semblance of its original condition or at least further deterioration was arrested.

To turn to the U. S. Fish and Wildlife Service's role in surface protection of other federal lands, a substantial part of our work concerns review of proposed uses and recommendations concerning developments

on other federal lands.

This activity is in response to a number of congressional directives, principally the Fish and Wildlife Coordination Act, but also others such as the Endangered Species Act, the Bald Eagle Act, the Mineral Leasing Act.

While our role varies with the situation, in general Fish and Wildlife Service responsibility is designated to evaluate the impact of proposed developments or uses on wildlife resources and to recommend mitigating measures to the action. In some cases, there is mandatory review (water development programs) and the requirement that wildlife and habitat be given equal consideration with other resources in any development permit. In other cases, arrangements are provided for agreements whereby two or more agencies cooperatively can meet the requirements of particular legislation such as the protection of bald eagle nesting sites or the protection of the habitat of rare or endangered species of wildlife.

In summary, we thus have a mandate and the operational mechanism for quite rigid protection of the habitat and surface resources of National Wildlife Refuges. The Fish and Wildlife Service has also a delegated responsibility and interest in the protection of wildlife habitat on other federal lands, a responsibility exercised generally in an advisory capacity.

Policy and Procedures on Surface Protection National Park Service

Bryan Harry

ABSTRACT
The National Park Service administers parks, monuments, and reserves with a purpose, as defined by Congress, "...to conserve the scenery and the natural and historic objects and wildlife therein and to provide for the enjoyment of the same in such a manner and by such a means as will leave them unimpaired for the enjoyment of future generations." Master Planning and the National Environmental Policy Act provide regulations and constraints of activities that might damage park natural or historic values or alter resources. Such surface-damaging activities as bulldozing fire lanes are done within the law but outside planning, but attempts are being made to fight fire with less surface-damaging means and to rehabilitate damaged areas. Fires are also being used to naturally perpetuate plant communities such as sequoia.

The National Park Service administers parks, monuments, and reserves with a purpose, as defined by Congress, "...to conserve the scenery and the natural and historic objects and wildlife therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations."

Within this mandate, we plan, develop, and encourage those types of visitor uses which relate to enjoyment of a particular park's values--as long as these activities leave the park undamaged over the long haul.

The Park Service relies on Master Planning with interdisciplinary specialists, usually with public involvement, to preplan actions which may have effects upon the natural or historic values of a park area. Court cases generally have held that most matters that alter a park's resources, even modestly, or are controversial, must comply with the National Environmental Policy Act (NEPA).

Park uses that affect land surfaces obviously fit within the overview; surface land use or development in parks may be carried out only to the extent that law and regulation allow--rather than conversely. For example, snowmobile use must be planned for each area and defined before machines are used in parks. Mining is allowed in those places specifically defined by law and regulation--not broadly. Roads and trails are constructed only under the constraints of the Master Planning and NEPA process.

Park developments may be quite extensive. On one extreme, Yosemite Valley--7 square miles in extent--has facilities that easily accommodate its one and a half million visitors per year. A summer night's population there is about 10 thousand and sewer, water, campsites, hotel rooms, visitor center, stores, and jail are located within the Valley. Still, through the National Park Service planning process (along with NEPA guidelines), the resources of that park are being handed along to heirs in rather good shape. Past problems in Yosemite have dealt more with people vs. people conflicts than with damage to resources.

In some areas, we are seriously applying optimal capacities to the numbers of people and activities that can be handled at a given place at a given time. Yosemite Valley, the High Sierra, and river trips on the Grand Canyon now all have optimal capacity limits to protect park resources.

Some surface-damaging activities are still done within the law but outside the planning process. For example, bulldozed fire lanes don't follow a NEPA planning process. But we are beginning to fight forest fires with an ecological feel for the long-term impact of a D-9, and we are spending dollars to attempt partial restoration of fire lanes. Deliberate and natural fires are beginning to be used to keep natural processes involved in perpetuating plant communities such as sequoia.

We've had a century of experience in managing parks. A few years ago in much-visited Yellowstone, I took a 10-day hiking trip along a route that a fur trapper named Osburn Russel described in the 1830's. I crossed the same creeks, saw the same kind of vegetation, probably was run up the same tree by a grizzly that he was in the 1830's. In the 1950's Yellowstone annual visitation reached 3 million. But the only marks on the land that I saw as I hiked were foot and grizzly tracks.

Policy and Procedures on Surface Protection
U. S. Geological Survey

Rodney A. Smith

ABSTRACT
Surface protection responsibilities of the U. S. Geological Survey span all federal lands. The Conservation Division, one of four USGS operating divisions, is concerned with leasable minerals on federal lands; the Oil and Gas Supervisor has authority and responsibilities for oil and gas activities in his area and his office provides BLM and other federal agencies with advice, evaluation, and inspection services. The USGS staff also works with state agencies. Surface protection stipulations are incorporated in drilling permits and are derived from application plans and drill site inspections. Stipulations for production and abandonment are similarly derived.

Surface protection responsibility of the U. S. Geological Survey is somewhat different from the same responsibility of the other agencies and groups represented here. For the most part, their responsibilities are directed at a specific area that has been placed under their jurisdiction, whereas the Survey's responsibilities span all federal lands, whether they're unappropriated or acquired public lands or a national forest, wildlife ranges, refuges, or other designated lands.

I'd like to describe briefly the responsibilities of the Conservation Division and the Oil and Gas Supervisor and coordination procedures with other agencies before describing some of the specific responsibilities and procedures relating to surface management. Since the subject is the

protection of surface, I'm going to restrict my comments to those responsibilities pertaining to or related to surface protection. I'll also restrict them to oil and gas operations since that's the subject I know most about.

The Conservation Division is one of four operating divisions of the U. S. Geological Survey. The duties of the Conservation Division are largely connected with leasable minerals on federal government lands. The responsibilities include classification of the lands as to their mineral value and their water power and water storage values and the supervision of operations of private industry on mining, oil and gas, and geothermal leases on federal lands, on Indian lands, on the Outer Continental Shelf, and on certain Naval petroleum reserve lands.

The Oil and Gas Supervisor is in charge of the activities within his area. He has the authority and responsibility to require compliance with the lease terms, the oil and gas operating regulations, and other applicable regulations to the end that all operations conform to the best practice and are conducted in such a manner as to protect the environment, protect the deposits of the leased lands, and insure the maximum ultimate recovery of oil and gas or other products. The supervisor's jurisdiction extends to drilling and producing operations, handling and measurement of oil and gas and other products, and the determination and collection of royalty. He has the authority to shut down any operation and place under seal any property or equipment for failure to comply with the oil and gas operating regulations, or to recommend cancellation of the lease and forfeiture under the bond for noncompliance.

The Oil and Gas Supervisor also provides the Bureau of Land Management and other federal agencies with geologic and engineering advice or evaluation and inspection services in connection with management and disposition of the public domain. We must work closely with other surface managing agencies on any proposed oil and gas operations, especially in their area. We also work with other federal and state agencies which have jurisdiction or may be responsible in a specific area of the proposal. We especially work with the Bureau of Land Management, since it is the basic leasing agency and surface manager on the majority of the public lands in Alaska where there are oil and gas leases. Secretary of the Interior order number 2948 sets out specific procedures for close coordination between the Geological Survey and BLM with regard to oil and gas and geothermal operations on those leases where BLM is the responsible surface managing agency.

We also work closely and coordinate with other federal agencies which have surface management responsibility, such as the U. S. Fish and Wildlife Service with operations in the Kenai Moose Range. Periodically, we work with the Forest Service, where there are operations on forest lands, and with the Environmental Protection Agency, with its responsibilities under the Federal Water Pollution Control Act.

We work closely with several state agencies, particularly with the State Division of Lands and the State Division of Oil and Gas. In some instances, the operations are on state-selected lands or in others, there's a mix of federal, state, and private lands which may be in a unit calling for cooperation with the Department of Natural Resources. We also consult with the Alaska Department of Fish and Game, the Alaska Department of Environmental Conservation, and other state agencies with regard to environmental considerations.

Now I'd like to move to some actual surface protection procedures and talk specifically about drilling permits. An application for a permit to drill an exploratory oil or gas well must be filed with the Oil and Gas Supervisor and approval received before any work is done. The application must include a detailed well plan, accompanied by a separate development plan for surface use. Since the processing of an exploratory well application involves a detailed review of the drilling plan, environmental analysis, and an initial visit to the location, it takes considerable time to handle. Anyone who wants a permit should file well in advance.

A drilling permit must include a complete casing and cementing plan, a description of the blowout prevention equipment, and specifications including testing and testing frequency, a complete program on the drilling fluids that will be used, the testing, coring, sampling, and logging plans, and geological information. The development plan for surface use must include information on the area natural setting, including details of existing facilities, the topography, vegetation, and wildlife, etc., and the applicant's construction and operating plans, including access plans. This is important in Alaska because of scarcity of roads. Also required in the plan are the details for handling and disposing of waste material, including drilling fluid, combustibles, and noncombustibles, plans for handling and storage of fuel, and plans for restoration of the surface when work is finished.

The development plan must also include a contingency plan, including equipment available to handle uncontrolled spills of oil or other polluting substances, and a discussion of production, transportation, and marketing plans if a discovery is made.

When we receive complete drilling application and development plan, we send a copy of the development plan to the federal surface management agency and any other federal or state agency which has jurisdiction or responsibility in the area of operations. We request that they furnish us their comments on environmental disturbances and their recommendations. At the same time, we arrange a preliminary visit to the location with representatives of interested agencies and the operator to discuss the proposed plans at the well site.

After looking at the site and receiving comments from responsible agencies, the supervisor's office completes an environmental analysis. In most cases, the proposals are not determined to be major federal

actions under the National Environmental Policy Act (NEPA). Problems detected at the preliminary inspection, however, and comments and recommendations from the other agencies are often incorporated as stipulations to mitigate or reduce the environmental impact or disturbances. Examples of these are, a stipulation for nonoccupancy of a site near a historic peregrine falcon nesting area during the period that the falcons might be there, the relocation of proposed site from a hillside to a level site to avoid erosion and soil instability, relocation of proposed well sites out of suspected flood plains or out of streambeds in the event there's a flooding problem. In cooperation with the BLM, we've specified periods of operation to avoid surface damage during breakup or prior to freezing.

I'm not going to discuss the specifics of permits for production and abandonment except to say that permitting procedures pretty much follow the procedure for application for permit to drill. But I will discuss unit operations. Unitization allows the pooling of leases in a field or an area, the sharing of production from all lands in a unit, and development of separate tracts or separate leases by a single operator. Unitization provides maximum efficiency of production facilities so that it not only promotes orderly development, but it reduces surface disturbance by reducing the amount of land used for tank batteries, well sites, gathering lines, and other facilities. Much more land would be used and disturbed if the field were developed by a group of separate lessees, each trying to develop his lease independently to obtain maximum production. Most exploratory drilling in Alaska is under unitized operations.

Field inspection is an important phase of effective supervision and enforcement activities, especially for surface protection. For exploratory wells, field inspections must be made prior to operations, when the operator is starting construction and rigging up. Field inspectors also witness and inspect blowout prevention equipment and testing of equipment during other critical phases of operation such as running casing, blowout prevention tests, or plugging a well.

At least one inspection is made after abandonment. The final inspection often involves representatives from other agencies, particularly the agency that has surface management responsibility. For producing operations, the field inspection must be made in the initial phases to assure that proper equipment is being installed and used properly, that it is tested, and that adequate surface protection measures are being practiced. In addition, periodic field inspections are made to witness testing and calibration of measuring equipment and for pollution inspections. Inspectors also see that the operations are being conducted in workmanlike manner and do not cause undue damage to the environment.

Before closing, I have some additional comments; one concerns the status of federal oil and gas leases in Alaska. The surface disturbance due to oil and gas activities on federally leased land in Alaska is very small and should be declining. This is because few federal oil and gas

leases remain in effect in Alaska. The number of oil and gas leases has declined from more than 15,000 in 1960 to fewer than 1,900 leases at present. The remaining leases will expire in the next two years, except for a few leases that are producing. I don't know of any leasing proposal at present for federal lands in Alaska. There should be very little impact, therefore, from lease operations. Considering the progress in the Alaska Native Claims Settlement Act and the increasing need to find new energy sources, however, I think that we should move forward with renewed leasing on federal lands as soon as possible on those lands where there is petroleum potential and the petroleum activities are compatible with the other uses.

I'd also like to point out that one of the primary producing fields on public lands in Alaska is the Swanson River Oilfield, located on the Kenai National Moose Range. Production was started there in 1957 and through the end of November more than 150 million barrels of oil had been produced. These had production value of more than 560 million dollars, and the royalty value of that is approximately 66 million dollars. Much credit is due to the efforts of the U. S. Fish and Wildlife Service and the operator of the Swanson River Unit; I believe that the oilfield is an example of how a major oilfield can be developed in an area of high wildlife and recreation values with minimum disturbance. This oilfield is based upon a nonrenewable resource which will be depleted and abandoned in a few years, and appropriate restoration can be accomplished after that.

Policy and Procedures on Surface Protection

State of Alaska

Dr. Michael C. T. Smith

ABSTRACT
Under the Statehood Act, the State has selected about 32 million acres of land that have been tentatively approved or patented to the State and over which the State maintains jurisdiction as of November 1975. Regulation of uses on these lands is achieved by legislative or administrative designations which set aside lands for special uses such as parks and recreation, or which recognize those which have special resource values. Remaining lands are protected by existing land regulations which specify types of equipment use. The State has no equivalent of the federal executive order under which ORV use on federal lands is regulated. Use of heavy equipment on state lands is regulated by either an operating plan permit or a miscellaneous use permit. Permit applications to the Division of Lands are reviewed by the appropriate district office or by the particular resource section concerned in cooperation with other interested state agencies, usually the Departments of Fish and Game and Environmental Conservation. Problems remain in the regulation of ORV's on state lands and on the management of lands which the State has selected but which are still managed by the BLM until tentatively approved or patented to the State. An interim arrangement for joint management has been discussed with the BLM.

In talking about state lands, I think I should define that "universe" first before discussing surface protection policy. Under the Alaska Statehood Act, the State is entitled to select more than 100 million acres of

land. There are three steps in the selection process. First, the State selects its lands. Second, the selections are tentatively approved to the State. At this time the State obtains effective management jurisdiction over the lands it has selected. The third step is the formal patenting of the lands to the State.

Since Statehood, the State has selected approximately 32 million acres that have been either tentatively approved or patented to it as of November 1975. A huge amount of lands remains to be selected, and I will discuss this later.

Of the lands now under state jurisdiction, certain land designations and the regulation of surface activities depend upon actions by both the state Legislature and the executive. Legislatively, we have lands which the Legislature has set aside as parks, recreation areas, and other such areas. The legislation includes specific guidelines as to how these areas are regulated.

By administrative action, some areas are designated as "special use" lands areas. These are places that have special scientific, historic, archeological, biological, recreational, or other resource values that might be harmed if they are not protected. We can promulgate regulations under these designations as tight as we feel is necessary in each situation.

As a percentage of all state lands, protective legislative and administrative designations are small. The majority of state lands are in a category which we manage under existing land regulations. These remaining lands are open to virtually all equipment uses found on an official "equipment list." At the time the regulations were drawn, these were particular pieces and uses of equipment which were thought to have relatively minor impact upon the land. The list includes portable field equipment, such as picks, shovel, augers, backpack drills, and similar tools. It also includes snow machines, jeeps, pickup trucks, and Weasels.

In recent years, use of vehicles in the category that might be called small ORV's has increased tremendously. As I will mention later, the State is probably behind federal agencies in regulating use of these vehicles because we have not had the prodding of an equivalent of the federal executive order.

Another equipment category for which no permit is needed for use is airborne equipment. For example, state biologists on control operations in helicopters can land to pick up wolf carcasses without permits.

The equipment list is flexible. We can change it to regulate equipment developed by new technology as soon as it comes along, making regulations stricter or more lenient as necessary.

For use of heavier equipment on state lands a permit is required. Basically, permits fall into two categories: operating plan permits and

miscellaneous land use permits. Suppose an operator wishes to use equipment that is not on the equipment list, that is, big machines like cats, major trucks, or trailers, and he has some type of contract with the State--either a permit or lease, such as a coal prospecting permit or lease, an oil and gas lease, timber sale, mining lease, or specific right-of-way. When he has such a relationship with the State, his land use and movement across the surface is determined by an operating plan permit. This is basically a permit that covers his whole operation, not only movement but also his on-site operations. In this regard, we say that we have a special contractual relationship.

For the other category, which we call miscellaneous land use permits, operators do not have a contractual relationship with the State. For instance, when an oil and gas company is conducting seismic operations to get information which may lead to its ultimately getting a lease sale, any action across state lands is regulated by a miscellaneous land use permit. Seismic exploration for oil and gas is probably the dominant land use under these permits. Locatable mining operations also would take a sizeable portion of the miscellaneous land use permits. These again are operations where prospectors locating minerals on state lands need to use heavy equipment.

Another land use requiring regulation is the simple movement of equipment from point A to point B across state lands. A recent example would be the movement of drilling rigs and other equipment across North Slope lands into Petroleum Reserve No. 4.

Basically, the procedure would begin with an application to the State Division of Lands. Under an operating plan permit relationship, the section of the Division of Lands which administers that particular contract or lease would have the permit-issuing function. For instance, our mineral section would handle operations on oil and gas leases, coal leases, coal prospecting permits, and other mineral leases and permits.

Except for the North Slope oil and gas operation, miscellaneous land use permits generally are issued by the district offices. These, again, are usually not a contractural relationship with the Division and are handled on a local district basis.

For both the operating plan permits and the miscellaneous land use permits we have good liaison with other state agencies--mainly the Department of Fish and Game and the Department of Environmental Conservation. They review virtually all of our permits. Their comments, after consultations between agencies, are included in our permits which are then issued to the operator. Field checks and inspections usually are handled by the district office staffs of the Division of Lands, cooperating with district office staffs of the Departments of Fish and Game and Environmental Conservation.

All operations under either of these types of permits which could threaten damage to the surface are bonded. We have specific bonding

schedules which require many of the large operators to have statewide bonds, similar to those discussed earlier for operators on federal lands. The permits generally have certain standard stipulations and are changed or augmented according to each specific situation. This allows flexibility to meet the special needs of the wide array of situations we encounter.

In conclusion, I should like to discuss two problems that the State faces in protecting surface land values. Federal agency representatives have indicated that the State has a stronger position in regulation of the heavy, large equipment, particularly that used for mining. But when we talk about the small operations, especially those using small ORV's that have resulted from the recreation boom, the State seems not to have addressed the problem to the extent that federal agencies have. Federal agencies, of course, have been under the direction of an executive order.

Finally, a problem I alluded to earlier is the never-never area of state-selected lands that are awaiting tentative approval and patenting to the State. Once the State has selected lands, they essentially go into a form of limbo; the State does not really have control over them as the BLM still manages the selected lands. Yet, the BLM serves somewhat as trustee for the State, since it is assumed that those lands eventually will come to the State. We have approached the BLM concerning the possibility of setting up some interim management or joint jurisdiction so that the State can take part in land use decisions concerning these lands. The BLM has responded favorably, and I think the ball is now in our court to pick up and move.

Because of the large amount of land under state selection now--probably 35 million acres with an equal amount to be selected, the large amount of time it takes after selection until tentative approval is given, and the press of the Claims Act [Alaska Native Claims Settlement Act] and the BLM's need to address the Natives' 40 million acres, some joint juristiction arrangement is urgently necessary as we are going to have lands in this limbo status for a long time into the future.

The Role of the North Slope Borough in the Regulation of Surface-Disturbing Activity on the Arctic Slope

Eben Hopson

ABSTRACT
The North Slope Borough, rural Alaska's only regional home-rule first-class borough, is pioneering home-rule development for all Native people in rural Alaska and Canada. Home rule must include power to protect traditional values of land against new industrial values. While specific ordinances to regulate surface-disturbing activities have not been made, the Borough Planning Department is working on many land use issues and the Borough's Traditional Native Land Use Policy is being developed. The Borough supports transfer of NPR-4 to the Department of the Interior. The Borough plans to monitor and regulate surface-disturbing activities in the Borough and is anxious to work closely with agencies represented at the surface protection seminar.

The North Slope Borough is rural Alaska's only regional home-rule first-class borough, and we are aware that we are pioneering the development of home-rule for all our Native people throughout rural Alaska and Canada. I feel our developing traditions of home-rule will have little lasting meaning for our people unless "home-rule" means that we can protect our land and game from environmental disturbance and degradation. Home-rule in the Arctic must mean that we ourselves have the power to protect the traditional values of our land against the new industrial values symbolized by the Prudhoe Bay oilfield.

The North Slope Borough is less than four years old. We have had

many difficult organization tasks to accomplish. As a result, we have not been able to enact Borough ordinances necessary to regulate surface-disturbing activity within our Borough. However, we have been able to build a good Planning Department, and our Planning staff is hard at work with the issues that face us and which are demanding Borough attention. These issues include:

1. Classification of d-1 and d-2 lands.

2. Classification of Regional Corporation lands withdrawn but not selected.

3. Classification of village lands withdrawn but not selected.

4. Conveyances of village selections to municipalities for community expansion.

5. The use of the Alyeska pipeline corridor and associated haul road.

6. Routing and development of the proposed trans-Alaska and trans-Canada gas pipelines.

7. Outer Continental Shelf and nearshore oil and gas development.

8. The exploration and development of NPR-4 for oil, gas, and coal.

9. Cataloging traditional Inupiat land usage, and the development of the Borough's Traditional Native Land Use Policy.

The North Slope Borough's Traditional Native Land Use Policy will enable us to have a single set of criteria from which all our Borough's land use regulatory decisions will proceed. Our Traditional Land Use Policy statement will be used in the identification and assessment of our traditional land use patterns and will include consideration of:

1. Historic use

2. Archeological value

3. Areas of cultural significance

4. Areas of important subsistence hunting, fishing, and gathering

5. Access to energy fuels.

The accelerated exploration of NPR-4 has caused us to speed up our land use regulatory planning and organization. After meeting with Congressman Melchor in Barrow, we have had our people in Washington, D. C. work with the Conference Committee on H.R. 49.

In the course of our work in Washington, we decided to actively support the transfer of NPR-4 to the Department of the Interior. An example of the reasons that led me to abandon my previous neutrality regarding the transfer of NPR-4 jurisdiction was Nathaniel Reed's letter of October 24, 1975, to the Secretary of Defense. I'd like to quote from a paragraph in that letter:

"When this Department reviewed the Navy's Draft Environmental Statement (DES) on PET 4, the cursory treatment given impacts of petroleum development on wildlife, particularly migratory birds, in this near-pristine area was disturbing. The exploratory program was well underway even as the DES was distributed for comment. The DES asserts, however, that annual operations were to be confined to the winter months...'until...designated tasks have been completed or until signs of an approaching spring thaw occur, whichever comes first.' We regret that this statement has not been borne out. In fact, extensive damage is occurring to the tundra in the vicinity of Cape Halkett and Teshekput Lake because rolligons--large, wheeled freight vehicles--continued working as late as July, as evidenced by the accompanying photographs taken by members of a U. S. Fish and Wildlife Service waterfowl banding crew. This happened long after the summer thaw had softened the tundra well beyond the point where it could sustain overland traffic without severe degradation. This development and evidence of other incidences which have come to our attention, moved us to contact you concerning the seriousness of this matter, with its implications for the deleterious manner in which future PET 4 activities may be carried out.

"Aside from the problems caused by trails and ditches created by rolligons, additional problems are apparent in the condition of the test well site and camp south of Cape Halkett. As shown by the attached color photographs, the camp, apparently located when the landscape was obscured by snow, presently stands in a shallow lake. The rolligon scars between the Lonely DEW-line site and Cape Halkett are apparently the result of an effort to salvage remaining fuel and other stores at the flooded Cape Halkett site before freeze-up locked materials into the ice."

After pointing to several laws and treaties respecting the preservation of Arctic Slope animal and bird species, Assistant Secretary Reed said that:

"Equally important are the needs of local Natives to use the area and its resources for subsistence purposes. These people are increasingly conscious of the need to conserve waterfowl in order to preserve their culture or lifestyle and have no qualms about flexing political muscle if the situation dictates."

We intend to use our political muscle to monitor and regulate surface-

disturbing activity within our Borough. Our new home-rule government is an important part of this muscle.

I was happy to be asked to speak at this conference, to discuss the developing role of the North Slope Borough. Many of you here are able to help us organize to meet our responsibilities. We need all the help we can get, and I am anxious for the agencies you represent to work closely with our Borough as you carry out your missions within the Borough.

session seven

CHAIRMAN: Dr. Jerry Brown, Research Soil Scientist
U. S. Army Cold Regions Research and Engineering Laboratory
Hanover, New Hampshire

SURFACE PROTECTION--continued

Soils Research Needs

Byron R. Thomas

ABSTRACT
Soils behavior in different actions or management situations must be known before the soil is disturbed if sound soils management is to be achieved. This is true for mineral and organic soils as well as areas underlain by permafrost. Soils scientists can provide the behavioral characteristics of each type of soil with various uses as well as construct soils maps showing locations of different soils.

In deciding mapping scale or intensity, the scientist must consider the objectives as well as technology, money, manpower, and time constraints. There is a possibility that a remote sensing technique now being developed can be used to locate permafrost in areas where it is discontinuous.

I have been impressed this week by the scope of the problems identified and the magnitude of the area involved. I have also heard of a great diversity of unsolved problems. A common theme that has run throughout most of the seminar is that more basic inventories are needed. This is the subject as it relates to soils that I intend to address this afternoon.

Soil behavior in different actions or management situations needs to be known before the soil is disturbed if sound soils management is to be achieved. The land management agencies' operations must continue with

or without the proper data base. Often, this predicament forces us to apply remedial measures to the land instead of enlightened management decisions.

First, let's look at this relative newcomer to BLM known as a soil scientist. Do we need him? My answer is yes. It takes a trained soil scientist to understand soil classification, soil mapping, and soil behavior. This understanding also includes the idea that contrasting soil bodies may occur in very short distances--some as short as a few feet. Each soil has its own suitabilities, limitations, and capabilities.

Each of these factors is based upon the soil's chemical and physical properties as well as items such as slope gradient and aspect. It is the soil scientist's job to integrate the technical soils data and make interpretations for proper soils use. He can also predict how soils will respond to specific treatments. These interpretations and predictions may be used by the land manager to assure conservation of the soils resource. It also allows him to make knowledgeable trade-offs, as far as the soils are concerned, in his management decisions.

Before I came here, I reviewed all the soil survey reports that have been published by the Soil Conservation Service for Alaska. These reports revealed that in the surveyed areas in Alaska (whether at Fairbanks, Anchorage, or Juneau) soils were contrasting and occurred in diverse patterns, just as soils do anywhere else. Some examples are shown in Tables 1, 2, and 3.

Soil inventory processes are determined by time, money, and manpower constraints. I would like to tell you about the soil inventory procedures we use in Oregon to work within these constraints. They can be modified or adapted and used in Alaska.

We map to the 3rd order intensity. This allows one to cover large tracts of land at a relatively low cost. To make the information more useful, we obtain soils data for suitabilities and limitations at a 2nd order level. In other words, we have a broad type of map but detailed information about every soil within the area. One of the most important factors, in my opinion, is having a soil scientist assigned to the district. The scientist is then able to provide training, detailed information, and project (on-site) services. The district soils man is also invaluable in providing intimate soils knowledge for the planning system.

Table 4 shows a range of soil mapping intensities by broad purpose and size of delineations. Constraints and objectives are the two factors which determine the order of soil survey to be used in a defined area.

Solutions to Alaska's soils inventory problems could lie in the same procedures with the orders of magnitude changed to suit conditions. Here are some examples of how these procedures could be adapted:

Table 1. Permafrost soils in the Fairbanks area.

SOIL SERIES	HORIZONATION	DEPTH OF PERMAFROST TABLE	DRAINAGE	MANAGEMENT
Bradway	4"mat of moss and roots 0-2" mucky silt loam 2-36" very fine sandy loam	3-4 feet	Poorly drained	Short season crops with drainage
Tanana	5" mat of moss and roots 0-4" silt loam 4-20" silt loam	2-4 feet	Imperfectly drained	Grow all crops in area without artificial drainage

Table 2. Mineral soils in the Susitna Valley.

SOIL SERIES	HORIZONATION	ROOT PENETRATION	WATER TABLE	SUITABILITIES FOR GENERAL USE
Moose River	3" organic material A1 0-3" silt loam C1 3-6" silt loam C2 6-42" sand & silt	15 inches	Near surface	Severe (high water table)
Nancy	2" organic material A2 0-2" silt loam B 2-9" silt loam A2 9-10-1/2" silt loam B 10-1/2-16" silt loam C1 16-24" silt loam C2 24-40" gravelly sand	30 inches	Not a factor	Slight to moderate (slippery)

Table 3. Organic soils in the Susitna Valley.

SOIL SERIES	HORIZONATION	SOIL SERIES	HORIZONATION
Clunie	0-18" sphagnum moss 18-37" peat 37-50" silty clay loam	Salamtof	0-9" sphagnum moss 9-60" peat

Organic soils are separated from one another by:

- Stages of composition
- Depth
- Temperature regimes
- Presence or absence of sphagnum
- Chemical properties (sulfate)
- Ratio of materials in different stages of decomposition

Table 4. Intensity of soil mapping.

ORDER	PURPOSE	MINIMUM SIZE OF DELINATIONS acres
1st	Intensive planning	1.5
2nd	Operational planning that requires each soil's suitabilities and limitations	1.5 to 10
3rd	General planning or extensive uses	6 to 640
4th	Broad planning (statewide)	100 to 1,000
5th	Very broad planning (regional	640 to 10,000

First, it is essential that a soils scientist be stationed at the district level to accomplish or coordinate the work. Inventories could be made with supplemental help from highly qualified summer workers. The work might proceed in three stages as follows:

1. Start with 5th order soil survey. This gives an overview and defines areas with potential problems. This order would not be used where there are known problems.

2. Follow with a 3rd order soil survey in selected areas of activity, corridors, or potential problems. This order would be appropriate to use in large (100,000 to 1,000,000 acres) known problem areas.

3. Conduct on-site investigations at the project level (order 1 or 2). Order 1 is used for items such as campgrounds or subdivisions.

Another approach might be to use two stages:

1. Start with a 4th order survey. This gives better detail at a state level. It is not appropriate for project work nor detailed planning.

2. Conduct on-site project survey to the proposed use of the site or area.

Examples would be a 1st order on campgrounds and 3rd order on corridors.

In addition to on-site investigations, plans and actions must be under way to incorporate the soils data into the BLM's Unit Resource Analysis and the Management Framework Plan.

Organized soils data must enter the BLM planning system in order to reduce the time the soil scientist spends on individual trouble spots. A person can spend so much of his time on individual trouble spots that he doesn't have time to analyze the total picture.

I now want to make you aware of the possibilities of a new remote sensing feasibility study being worked on by Stanford Research Institute. The system they are studying may allow us to map permafrost areas where it is discontinuous or allow us to determine the stratigraphy of other "near" surface features.

Before coming to Alaska, I called the Scientific Systems Development Branch in the Denver Service Center and asked if the system has possibilities in Alaska. After consulting with specialists in radar and induction systems and discussing this question, they concluded that it was a good possibility.

The first phase of the study shows that there is a good chance that

a radar system can be constructed that could delineate areas of permafrost. I would urge that those persons in Alaska interested in this technique contact Ralph Morrill in the Denver Service Center. The Scientific Systems Development Group would approach the problem in an orderly manner by defining the problem, collecting and reviewing available literature, making a short feasibility study, and conducting field trials with existing or modified equipment.

To summarize my discussion, I should like to emphasize that soils managers should have three activities operating concurrently:

1. Continue hot-spotting as needed.

2. Initiate research agreements to find answers to pressing questions.

3. Start incorporating the soils information in some way into the BLM planning system. This requires some inventory process, but we will never reach a planning level unless inventories are initiated.

Don't get caught in the trap of thinking about "standard procedures." Adapt, change, and modify. Don't overlook any practical alternatives. Then make your decisions with long-range goals uppermost in your minds.

Research Needs in Descriptive Vegetation Science in Alaska with Special Regard for Land-Use Planning and Management

James H. Anderson

ABSTRACT

Vegetation is a primary environmental component and natural resource structurally and functionally, and it is a fairly reliable and useful indicator of other components and resources. A wider acceptance of the central importance of vegetation in environmental affairs could promote some integration and focus in the current confusing hodgepodge of ecological concerns and actions.

Alaskan landscapes feature vegetations of remarkable diversity and complexity in association with many combinations of climatic, physiographic, zoological, human, and historical variables.

The present descriptive knowledge of Alaska's vegetation and vegetation-environment relationships is inadequate for current and foreseeable land-use planning and management purposes. The results of earlier studies cover only a small portion of the state and in general are so individualistic as to preclude comparison, synthesis, and extrapolation. An appropriate body of knowledge would contain formal, standardized typological descriptions of all the kinds of Alaskan vegetation; a geographically, floristically, and ecologically comprehensive agglomerative classification based on these descriptions; and intermediate and large-scale general purpose vegetation maps incorporating this classification.

Vegetation maps are the most comprehensive and comprehendible form

of information on vegetation and its environment, and they are, therefore, useful in making scientific and applied decisions. Properly interpreted, they can serve to some extent as maps of climates, soils, permafrost, wildlife habitat, agricultural potential, and recreational areas. An accompanying encyclopedic text to facilitate map interpretation can make a vegetation map more than a colorful wall decoration.

Alaska is far behind leading countries in the inventory of its vegetation through methodical description, classification, mapping, and related research. Furthermore, there seems to be a lack of concern here for such fundamental work.

Alaskan vegetation knowledge should and could be significantly improved and expanded during the next few years. Four recommendations for this would require (1) better acquaintance and communication among people concerned with the vegetation of Alaska; (2) trying to use, test, and expand the 1975 Fosberg-Viereck physiognomic-floristic vegetation classification; (3) mapping the state on the 1:250,000 topographic sheets using satellite imagery, to show greater spatial and classificatory detail than on existing maps, all within the fairly near future; and (4) establishing a group of vegetation scientists and technicians in the University of Alaska whose express tasks would be (a) the methodical description, classification, and mapping of Alaska's vegetation at intermediate and large scales; (b) the pursuit of related vegetation-environment research oriented toward increasing the indicator value of vegetation; and (c) the study of the origin and development of vegetation and soils.

This group would fill a vacancy which seems to exist between the more purely scientific enterprise on the one hand and land-use planning and management activities on the other.

Description of kinds of Alaskan vegetation, study of their ecology, and correlation with similar types elsewhere in North America and Eurasia is a fascinating job for the future, and it will provide a powerful tool for rational management of Alaska's resources.

J. Major (1973)

Introduction

Most of the land in Alaska and the rest of the world is conspicuously covered with vegetation. Vegetation is a primary environmental component and natural resource, and it is a fairly reliable and useful indicator of other environmental components and resources. It is of central importance structurally and functionally through primary production and its leading role in biogeochemical cycling. Vegetation is, therefore, basic in eco-

system definition and delineation. It follows that land-use planners and managers and ecologists of various sorts must take vegetation into account at the outset.

The landscapes of Alaska feature diverse and complex, mostly natural vegetations of foremost scientific and applied interest. The number of principal lifeforms and species is modest, but these occur in many combinations. Whereas single kinds of vegetation prevail in some areas, such as the kind characterized by black spruce, dwarfshrubs, and feathermosses on extensive tracts in the Interior, commonly there are numerous smaller and more or less distinct communities of several kinds, together constituting a landscape mosaic. The pieces in the landscape mosaics of Alaska will increase in number and variety with human disruptions and the spread of cultural vegetation. The latter includes all agricultural, horticultural, and disturbance-site, or man-influenced, vegetations.

Underlying all this diversity and complexity is an extraordinary array of combinations of climatic, physiographic, zoological, human, and historical variables and reciprocal ecophysiological responses. Combinations of major environmental variables constitute sites. A few variables, such as permafrost occurrence and thaw layer thickness, are of key importance in vegetation development and land use. In general, the extent of vegetation variation associated with a site type or individual key variable is fairly limited. There may be a tendency toward a 1:1 relationship between a vegetation and certain variables, as between sphagnum-dwarfshrub bog and shallow continuous permafrost, sedge marsh and no permafrost but high water table, and white spruce-dwarf birch-feathermoss woodland and deep permafrost table and coarse soil texture.

Vegetation, therefore, is more than a resource in its own right as timber, forage, or scenic object. It is also an environmental indicator, where the value and reliability of the full species assemblage are greater than of any single species. ". . . vegetation may be regarded as a tangible, integrated expression of the biogeocenose." (Küchler 1973: 512) This is why vegetation is important in nearly all ecological and land-use activities. Soil mapping, hydrologic studies, and wildlife management, for example, all lean heavily on vegetation information for determining the variables or conditions of interest.

Thesis

The planning and management of land use and natural resource exploitation in Alaska have become of special importance and widespread concern. The thesis of this paper is that descriptive knowledge of Alaska's vegetation is inadequate for the planning and management decisions which will have to be made. Secondly, efforts should and could be made during the next few years to improve and expand this knowledge. It is proposed that a wider recognition of the central importance of vegetation in environmental affairs could promote some integration and focus

in the current confusing hodgepodge of ecological concerns and actions. It sometimes seems that vegetation is so prevalent and obvious that it is taken for granted and passed over. Vegetation scientists, with a formal and thorough botanical education, should be involved in most environmentally oriented programs.

A more adequate body of descriptive knowledge would contain (1) formal, standardized typological descriptions at the association level of all the kinds of vegetation in Alaska, (2) a geographically, floristically, and ecologically comprehensive and consistent agglomerative classification of the vegetation types based on these descriptions, (3) intermediate-scale, general-purpose vegetation maps for the whole state depicting the higher or broader vegetations in this classification, and (4) large-scale maps of actual and potential heavy land use areas depicting plant communities defined at the association level.

There are a few detailed descriptive vegetation studies in the literature and the files of various agencies, together covering a small portion of the state. In general, the individualism or limited scope of these precludes ready comparison and synthesis. An unpublished attempt to show equivalencies or partial equivalencies among described tundra and wetland vegetation units in the literature was made recently by D. F. Murray and A. R. Batten in the University of Alaska. Current studies also are individualistic, and they tend to be hastily organized and conducted, to ignore the primary importance of vegetation, to deal with only the more obvious environmental features, or to be single-purpose oriented, as toward the hurried writing of environmental impact statements. It may be granted that these studies serve their respective and supposed purposes. If they are not floristically, quantitatively, or otherwise weak, however, they lack comparability in the absence of attempts to identify purposes in more common terms and to standardize methods.

Comparability, especially in stand and type descriptions, is more important now than in the earlier, formative phases of vegetation science in Alaska. It is desirable for synthesis, generalization, and extrapolation to unstudied areas; for ecological regionalization (Küchler 1973); for evaluating one area against another with respect to potential or intended use; and for vegetation classification and mapping.

Vegetation Classification

A classification is a logical and useful outcome of vegetation research. It can represent a synthesis of results, and it can express in succinct fashion the nature of intercommunity and community-environment relationships, depending on the scope and rank of its units. Beyond this, a vegetation map cannot be made without at least a provisional classification of the pieces in the landscape mosaic. The meaning and usefulness of a vegetation map depends largely on the classification it features. Classification is perhaps the oldest area of concern in vegetation science, and problems with it are as intractable now as ever.

This attention is not given to classification in ignorance of the individuality of species distributions and the continuity in vegetation. Vegetation transitional between more nearly uniform stands can be seen by almost anyone to occupy significant portions of Alaskan landscapes, and the widespread and frequent intergrading of vegetations along environmental gradients and complex-gradients could be demonstrated in almost any respectable set of data (see Whittaker 1973; Orloci 1975). The drawing of meaningful plant community boundaries is a longstanding problem. Some will say this is impossible and that classification is, therefore, unrealistic.

The typological classification of vegetation is indeed unrealistic inasmuch as it is an abstraction of reality. Nonetheless, there are acceptable criteria and methods for describing type variation, for arbitrarily but meaningfully delineating vegetation units representing types, and for identifying units in abbreviated fashion according to diagnostic species and variable states. These criteria and methods are presented in modern books and papers, and by learning and applying them, those concerned with Alaskan vegetation could increase their knowledge and make it more orderly and usable. Vegetation mapping could then proceed (Küchler 1967; Shimwell 1972; Whittaker 1973; Mueller-Dombois and Ellenberg 1974; Orloci 1975).

An effort in vegetation classification in interior Alaska is being made by Viereck (1975). His two-level physiognomic-floristic classification includes 11 formation classes and 33 vegetation units (types), based on literature descriptions and firsthand field experience. The validity and usefulness of this classification will be tested and possibly increased as its descriptive base is improved, partly through an ongoing program of the U. S. Forest Service Institute of Northern Forestry at the University in Fairbanks and as it is broadened in scope to comprise additional classificatory ranks and to accommodate vegetation in the rest of the state. A virtue of Viereck's classification is that it is an extension of the well-known Fosberg classification of world vegetation based largely on physiognomic criteria (Fosberg 1967; see also UNESCO 1973 and Mueller-Dombois and Ellenberg 1974; 466-488). Thus Viereck's classification features relatively good internal order, and its higher classes should be comparable wherever the Fosberg classification is applied. Viereck's is one of the first published attempts to apply an authoritative, comprehensive classification developed elsewhere which should accommodate Alaskan vegetation. A tentative application of the related UNESCO classification to some subarctic alpine tundra vegetation in Alaska was made by Anderson (1974c: III-11). Viereck's classification and improvements of it should be useful for some time as an organizational aid or a working hypothesis for various projects, and in small- and intermediate-scale vegetation mapping in Alaska.

By the natural course of things, we would no doubt begin eventually to describe and classify vegetation in greater detail and according to more refined concepts than is now being done, and we would aim for a regional

or statewide extension of such treatment. This would involve describing vegetation units according to complete floristic inventories and species importance evaluations as well as analyzing plant community distribution and function with respect to a more complete set of environmental variables. To a considerable extent, the results of these studies would be brought together on large-scale vegetation maps. This kind of work would lead to studies of exact responses to various human impacts of narrowly and realistically defined and comparable vegetation units.

The objective of thorough floristic treatment is important for at least two reasons. One is that the full floristic composition of communities is the best single expression of intercommunity and community-environment relationships and the significance of certain historical events, such as fires. Secondly, thorough floristic treatment could enable a more nearly realistic classification than now can be done, one somewhat less an abstraction of the landscape mosaic and more appropriate to large-scale, higher-probability vegetation mapping (see below). An a posteriori agglomerative classification is recommended, in contrast to existing regional classifications which are more or less a priori and subdivisive.

The following is suggested as a practical application of the full floristic composition. The purpose in this example is to evaluate quantitatively the susceptibility of a community to a given kind of disruption. Rate each species individually in terms of its response to the disruption as determined through observation or experimentation in the field or laboratory. A several-step scale could be devised as seemed appropriate. Multiply each rating by a standard species importance estimate, such as cover-abundance value. The product would be the response index for the species in the particular community. Total the species response indices to obtain a community susceptibility rating or index. Use such indices to compare communities, even where some species were of common occurrence. Use them also in conjunction with the vegetation map, to prescribe land-use patterns appropriate to the landscape involved.

In an a posteriori classification, preconceived notions about the nature of the vegetation are deemphasized, and subjectivity is of little importance beyond the standardization of sampling procedure and, perhaps, the selection of sample stands. A set of thorough, standard descriptions of stands selected to sample the range of variation in species assemblage and environmental interaction is an initial goal. In an a posteriori agglomerative classification, floristically similar stands are grouped (agglomerated) manually or automatically by logical or statistically verifiable techniques. The groupings are the basis for descriptions of plant community types or associations. Stands representing these associations would be the entities to depict on large-scale, general-purpose vegetation maps. Soil types or specific variables highly correlated with associations could also be identified on the maps. The standard field procedure would include describing soils and measuring key environmental variables.

Associations may be grouped in syntaxonomic categories of several higher ranks according to criteria of broader value. Association complex-units could be used for a new generation of small- and intermediate-scale vegetation maps. These maps would represent syntheses of detailed vegetation information, rather than the provisional generalizations and extrapolations from a limited data base represented on existing small-scale maps.

Associations also may be subdivided according to finer species importance variations and accompanying subtle environmental differences. Vegetations representing infra-association categories would be appropriate for very large-scale vegetation maps, which are desirable for planning intensive uses of specific small areas.

Vegetation Mapping

The vegetation map is a comprehensive, readily comprehendible, and usable form of vegetation and related environmental information. It is, therefore, a basic tool in planning and management, and it can suggest hypotheses and show areas needing further research. The general purpose vegetation map is of chief concern. This portrays the distribution of well-defined vegetation units and perhaps a principal associated environmental variable, usually soil type, but does not depict any special botanical or environmental feature. General purpose vegetation maps at small and intermediate scales are those of the JFSLUPCA (1973) and Anderson (1976). Special purpose vegetation maps would emphasize, for example, the distribution of potentially commercial timber (e.g. Anderson 1974b), the areal extent of natural forage or "rangelands," or permafrost distribution and thaw layer thickness as determined through vegetation.

The vegetation map is a map of plant resources per se, and properly interpreted, it can serve more or less as a map of climatic conditions, parent materials, soils, permafrost, wildlife habitat, agricultural potential, and recreational areas. It constitutes primary information for the actual mapping of these items. Vegetation map interpretation should be facilitated with an accompanying encyclopedic text treating each map unit class botanically and environmentally. Available information pertaining to vegetation dynamics and function should be included in the text. The possible course of succession and primary production are of chief concern. The use of such a text can make the vegetation map more than a colorful wall decoration.

Some kinds of interpretation which can be made with the vegetation map are of immediate importance to land-use planners and managers. For example, associations or other vegetation types could be rated with respect to susceptibility to different kinds of disruption, such as off-road vehicle travel, oil pollution, and fire. One possible rating scheme was suggested above. Thus the map would show areas where off-road vehicle use should be prohibited because of the scenic or other damage it would

do, as well as areas where such use would be tolerable, at least from a nonesthetic standpoint. Persons involved in petroleum exploitation would be in a better position to predict the consequences of an oil spill of given magnitude at any point in the landscape. Whereas the proper vegetation map would present topographic and other physiographic information (topographic maps should be used as base maps), it could be seen where the spilled oil would flow and just which plant stands would be affected. The designing of an oil-spill cleanup program could, therefore, be facilitated by the vegetation map used in conjunction with research-derived knowledge of cleanup procedures appropriate to the different kinds of vegetation represented on the map. This knowledge would ideally be contained in the text accompanying the map or later revisions of the text.

Enlightened fire management decisions may be made through use of the general purpose vegetation map. The fire susceptibility, or flammability, of different vegetations and the ecological consequences of their being burned are known and becoming better known through basic research (Viereck 1973, 1975). Thus the map, used in conjunction with current weather information, could help in predicting the broader consequences in the landscape of allowing a fire to burn and spread, or it could indicate that a fire ought to be extinguished.

For additional examples, it is noted that vegetations can be regarded in terms of their forage or animal shelter merits, especially when their productivities are known. The vegetation map, therefore, can depict the areal extent of possible caribou range or ptarmigan or moose habitat, etc.

The general purpose vegetation map is a fundamental kind of resource map and ought to be one of the first made. It is not a panacea, however. It cannot be expected to serve a specific purpose as well as an actual map of the variable of immediate concern. Nevertheless, it can nearly always serve to some extent in the absence of other kinds of maps because of the indicator value of vegetation. It would be of interest to a larger and more diverse user community than any other single kind of resource map. These considerations are important in Alaska, where special interest agencies, such as the U. S. Forest Service (concerned with commercial timber, among other things) and the U. S. Soil Conservation Service (concerned with soil capabilities and rangeland characterization, among other things) have so far been able to inventory and map only small parts of the state in desirable (for them) fashion.

Vegetation mapping is done at various scales, from small, through intermediate and large, to very large scales. These are defined, respectively, as smaller than $1:10^6$, $1:10^5$ to $1:10^6$, $1:10^4$ to $1:10^5$, and smaller than $1:10^4$. The meaning and usefulness of the vegetation map depends on its scale as well as its classification. The scale, in fact, governs to some extent the nature of the classification which can be used. In general, small-scale maps can depict only broadly defined vegetations, whereas larger scale maps can portray vegetations of narrower and more meaningful

definition.

In Alaska the extent of vegetation mapping is modest, as is the description, conceptual delineation, and classification of vegetation types prerequisite to the spatial delineation of vegetation units in mapping. Existing maps for the state are of small scales and depict only broadly defined vegetations (e.g. JFSLUPCA 1973). On these maps, even the smallest units represent large land areas, and it is uncertain that an indicated vegetation actually occurs at a random point in the landscape. Unfortunately, estimates of the probability of such occurrences are not provided, although this might be possible through extensive field or air photo sampling.

Reference is here made to the concept of vegetation map probability. Estimates for each map unit class are desirable. These could be averaged, with weighting according to the total area of each class, for an overall vegetation map probability estimate.

Even our superficial acquaintance with the diversity and spatial complexity of Alaskan vegetation suggests that at small scales, vegetation map probabilities are too low for modern needs. The raising of vegetation map probabilities through mapping at larger scales is an important goal. On larger scale maps, probabilities are increased, if not quantified, because the smaller map units represent smaller land areas. In general, vegetation diversity decreases as area decreases. The most interesting and useful products will be large-scale maps of narrowly defined vegetations, or plant communities in the strict sense. A few large-scale but individualistic vegetation maps have been made (e.g. Johnson et al. 1966; Anderson 1974a; Racine, in prep.). A published example of a very large-scale vegetation map is that of Webber and Walker (1975) in the Prudhoe Bay area. Other very large-scale maps of the Prudhoe Bay and Barrow areas are in preparation by these persons and their colleagues.

Further Considerations

We seem now to be entering a time when vegetation knowledge at the association level and a comprehensive a posteriori agglomerative classification will be necessary for the increasingly numerous local and specific kinds of problems. (See, for example, discussions of right-of-way vegetation management problems by Egler and Foote 1975.) It is of topical interest that a large-scale map at 1:63,360 for the proposed trans-Alaska pipeline corridor, incorporating an a posteriori classification, could have facilitated early decisions pertaining to parent materials, soils, ground water, permafrost, and wildlife habitat. Furthermore, as a comprehensive portrayal of the primeval landscape, the map would have been of everlasting value. It might have been made in two years by two vegetation scientists and several technical assistants, with concentrated summer field programs, the good aerial photos which were available early on, and the considerable logistical support potentially available from

the oil industry. The cost in 1970 could have been less than $100,000. Such a map would be of value if made now, perhaps with satellite imagery for economy, for its environmental indicator uses. In addition, it could, as was discussed earlier, enable prediction of the impact in the landscape of an oil leak or spill, for organizing cleanup procedures. Furthermore, it would probably become indispensable in revegetation and surface restoration and the managing or predicting of plant succession in disturbed places. The Canadians appear to appreciate the value and timely pursuit of such work, for their Environmental-Social Program contains a number of monographic studies and maps of vegetation and soils (e.g. Forest Management Institute, Canadian Forestry Service 1974).

The United States is behind the west European countries, the Soviet Union, and some other countries in the organized and methodical description and classification of its vegetation, and it has comparatively little to show in intermediate and large-scale vegetation maps. Furthermore, there seems to be little interest in pushing ahead in descriptive vegetation science. Alaska is well behind the rest of the United States in these matters, and the situation here could become severe as Alaska's importance increases. Instead, the United States is emphasizing research on vegetation and ecosystem function and theoretical aspects of structure and function. Perhaps this tends to overlook the fact that the results of such research will be of highest value only if they can be extrapolated regionally on a sound descriptive base. This especially concerns extrapolation of primary productivity and factors influencing it. Descriptive research as advocated in this paper on the one hand and functional and more theoretical research on the other hand both need to be pursued vigorously and on broad fronts.

France, with less than two fifths the land area of Alaska, and with mostly cultural vegetation, has two vegetation mapping agencies supported by the federal government. One of these aims to map the entire country at the large scale of 1:20,000 (Küchler 1967: 8). Germany, Switzerland, and others also have institutes more or less devoted to geobotanical research, including vegetation mapping. This emphasis in these countries surely results from dense populations, widespread and intensive economic land use, and extensive, though more civilized (i.e. mostly nonmotorized), outdoor recreation. It seems, however, that some people in influential positions desire or expect the same high degree of land use and resource exploitation for Alaska. Be this as it may, it is prudent to prepare for some population growth and accompanying development and degradation because of the state's appealing and abundant esthetic and potentially commercial resources. Alaskans are in the unique position of having a chance to inventory their natural vegetation through methodical description, classification, and mapping. This could still be done before very much man-caused change occurs. In fact, the inventory would serve, in addition to the purposes discussed elsewhere, as a basis against which to evaluate man-caused change.

In the Soviet Union, vegetation research and mapping for scientific

and applied purposes has been under way for many years (Shetler 1967; Aleksandrova 1973; Gribova et al. 1975; Karamysheva and Rachkovskaya 1975). This was impressively evident through displays and papers presented at the XII International Botanical Congress in Leningrad in 1975. Soviet vegetation maps are abundant, of small and large scales, of high information content, and they are beautiful. Soviet geobotanists are serious and assiduous. A considerable proportion of them are women. There may be a trend toward mapping the entire country, with 14 times the land area of Alaska. The Soviet Union contains extensive landscapes and ecosystems similar to Alaska's, and Alaskan vegetation scientists might learn a great deal from their Soviet colleagues.

A country-wide vegetation description, classification, and mapping program is under way in Western Australia, a state 1.7 times the area of Alaska, with extensive low-productivity lands and with a similar low population density. Several maps at $1:10^6$ have already been published (Beard 1975).

Vegetation description, classification, mapping, and studies of vegetation-environment relationships and the origin and development of vegetation (together constituting much of the field of geobotany) is one of the least costly areas of modern scientific inquiry. The concreteness and direct value of the products in scientific and applied affairs emphasize the favorable benefit/cost ratio. Only the simplest and least expensive equipment and supplies are needed, with the exception of computers for data handling and aerial photography or other remote sensing imagery. Computers are widely accessible, however, and aerial photography of potential usefulness and availability to the vegetation scientist is increasingly abundant in the files of various agencies in Alaska. Of special importance now is the thorough spatial and temporal coverage of Alaska by satellite imagery which could be used for economical regional vegetation work at small and intermediate scales (Anderson and Belon 1973; Anderson 1974b, 1976) and perhaps at large scales (Anderson 1974a).

Descriptive vegetation science is labor intensive, for much time must be spent in the field and even more in the laboratory working up the data and creating vegetation maps. The approximately 1:3 ratio of summer field time to nonsummer lab time in Alaska is favorable. The laboriousness should not hinder progress, however, because much of the work can be done by modest-salaried technical people with an undergraduate knowledge of ecological principles and a good knowledge of the flora or an ability to learn it efficiently. It is likely that technical vegetation workers could be employed who would enjoy camping and working for extended periods in more or less remote field locations, thus obviating the costs of frequent travel from home. A few professionals could work with a team of such personnel. This kind of labor intensive activity seems particularly worthy of consideration now vis-a-vis high unemployment and environmental concern.

To summarize, descriptive vegetation science is a complicated matter

because of the practically unlimited possible combinations of the life-forms and species and historical, environmental, and human variables involved in landscape development. This paper has presented only a few general remarks regarding (1) the inadequacy of the present descriptive knowledge of Alaskan vegetation, (2) the need for more complete and better organized knowledge for scientific and applied purposes, (3) the kind of knowledge about the vegetation which should be gained, and (4) the small amount of emphasis and work here compared with that in leading countries.

Work in descriptive vegetation science could now enjoy a new feasibility in the increasingly affluent and possibly more intellectually oriented Alaskan society.

Recommendations

In the rest of this paper are presented four recommendations by which descriptive knowledge of Alaskan vegetation could be significantly increased in the next several years. The implementation of these recommendations would require, beyond formal proposals from the scientific community, only a modicum of financial interest by the various land- and resource-responsible agencies at industry, state, and federal levels. Costs would be small alongside the generally anticipated revenues from petroleum and other resource exploitation enterprises.

1. There should be increased and regular acquaintance and communication among people concerned with Alaska's vegetation, for discussing and comparing goals, methods, and results. This especially concerns those whose responsibilities include description, classification, mapping, and the analysis of vegetation-environment relationships.

This communication could be promoted through spring and fall workshops and an occasional informal newsletter featuring summary reports and discussions of ideas and problems. Various other tactics also seem possible.

The benefits of better communication would be several. The following are suggested.

(a) There would be some chance for different and unrelated future projects to be conducted according to similar methods. Thus, each project could contribute beyond its primary purpose to broader goals in synthesis and analysis.

(b) Broader goals could be defined and discussed. Suggested projects for early attention are (i) preparation of an encyclopedia of vegetation-environment relationships, to be supplemented or revised on occasion to accommodate new information and (ii) organization in similar published reference form of the increasingly abundant but scattered information on vegetation responses to disruptions and on revegetation of disturbed sites.

(c) Whereas most considerations would depend on the recognition of vegetation units, needs and goals in classification and mapping could be treated in a more enlightened manner through the pooling of ideas and information.

(d) Deficiencies in background, knowledge, or skill of individual workers could be identified and thereby be reduced.

(e) Philosophies and methodologies well established elsewhere could be critically examined.

With regard to (e) it is especially recommended that there be an informed and no-nonsense consideration of the merits of the Braun-Blanquet approach to descriptive and analytical vegetation science, and that there be a serious attempt to design and conduct a program to test and evaluate its applicability in Alaska for methodical, regional vegetation inventory. (See van Groenewoud 1965 for an example of a methods comparison study in similar vegetation; Anderson 1970, p. 63-126, for an example of the application of Braun-Blanquet approach methods in the boreal forest in adjacent Canada; van der Maarel 1975 for a recent appraisal; and Westhoff and van der Maarel 1973 and Mueller-Dombois and Ellenberg 1974 for thorough explanations and instruction in the approach.) In non-North American countries, the Braun-Blanquet approach has been particularly important for its role in applied vegetation science.

2. Secondly, it is recommended that we become familiar with the Fosberg (1967) and Viereck (1975) vegetation classifications and try to use them. Whenever possible, new stand descriptions should be made according to the format, now under development, for formal type descriptions in the Viereck classification. In this way stands could be compared with the established vegetation units as well as with one another within and between projects and areas. Thus, new stands could be identified, as one might identify an organism or other entity according to an established taxonomy; or new stand descriptions could be the basis of new type descriptions and the expansion of the classification.

3. The vegetation of Alaska should be mapped at the intermediate scale of 1:250,000 using satellite imagery and the Viereck (1975) or a similar classification. Work in the University of Alaska has shown that Landsat imagery, even in photographic format, can be used in conjunction with topographic maps and available ecological information for economically mapping large areas at this scale (Anderson 1974a, b, 1976; McKendrick et al. 1974; Racine, in press). Maps with greater spatial and finer classificatory detail than is depicted on existing maps at this scale are possible. Mapping accuracies of about 90 percent are obtainable (Anderson 1976), and vegetation map probabilities are raised by the greater spatial resolution. Mapping should be on the standard topographic sheets, starting with map-areas of high population or of other heavy land use.

This mapping could be done by a small team working in the Univer-

sity. Another paper (Anderson 1976) demonstrates the method which could be applied. One possible plan would involve three full-time people; a professional Alaskan vegetation scientist, a technician specializing in vegetation cartography (a few students are receiving such training, particularly in Europe and the U.S.S.R.), and an ecologically trained assistant to help in both vegetation and mapping activities. In addition, the occasional services of a person specializing in remote sensing technology and of photographic personnel would be employed. This team could make ready for publication one map-area per month, on the average. The estimated cost is about $125,000 per year, or approximately $10,000 per map-area, or less than $2 per square mile. The production of 1:250,000 scale general purpose vegetation maps of 12 of the state's most important map-areas in the first year would be a timely and widely useful service.

It is noted that these maps would be a major step beyond the existing, unpublished maps of L. A. Spetzman (overlays of which are available at the Joint Federal-State Land Use Planning Commission for Alaska, in Anchorage) by virtue of their higher information content. They would be of greater spatial and finer classificatory detail. Nonetheless, the recommended satellite image-based maps are viewed as an interim product to serve until the best maps at this scale can be produced through the kind of descriptive vegetation work discussed throughout this paper.

The recommended program should be funded mostly by the state because of its potential statewide value, with contributions by industry and the several federal land- and resource-responsible agencies here.

4. Within the University of Alaska system, a working group or laboratory should be established whose express purpose would be the methodical description, classification, and mapping of the vegetation of Alaska. This group would coordinate, influence, and draw from the work of others wherever possible, but its primary efforts would be in the many areas not otherwise covered or not covered according to the necessary and standardized procedures which it would define and adopt. It would conduct research as required by the primary descriptive work to close gaps in knowledge of vegetation-environment relationships, thereby to increase the indicator value of vegetation. It would also investigate questions concerning the origins and evolution of vegetations, for vegetation history is an area much in need of scientific attention in Alaska, and it bears directly on the understanding of modern vegetation-environment relationships. The group would see to the communication improvements and the projects recommended in 1, above. It would try to be responsive to special needs in descriptive vegetation science, as in providing advice on specific practical problems.

The recommended group or laboratory should comprise three or four full-time professional vegetation scientists and perhaps six technical people and graduate students. It should be intellectually and

physically intermixed with the various University departments and institutes having some concern for vegetation and soils, geomorphology, glacial geology, and climatology. It would, thereby, incorporate several affiliated scientific personnel with separate funding sources. It should be administered by an established and capable institute, and its main work could be done in existing space. Its individual identity should be the Geobotanical Laboratory, for its concerns would include most of those of the broad discipline of geobotany.

A major early goal of the group should be the satellite image-based mapping proposed in 3, above. With this included, the overall cost would be about $500,000 per year.

It is believed that this group of description-oriented scientists and associated technicians would fill a vacancy that seems to exist between the more purely scientific enterprise on the one hand and, on the other, the dispersed and heterogeneous array of people responsible for land use planning and management.

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Resource Data Needs and Water Quality

Stanley Brust

ABSTRACT
The Federal Water Pollution Control Act Amendments of 1972 provide for control of water pollution, whatever its source. The EPA permit system for controlling point source pollution now is operating effectively, but the mechanism for controlling nonpoint source pollution still is being developed. The EPA defines effluent limits in issuing discharge permits, but from a technical standpoint, many other criteria affect water quality. These criteria are incorporated into the State Water Quality Standards. Nonpoint source pollution control is best accomplished at the local level, and the best single control is through land-use planning.

In 1972 the Environmental Protection Agency (EPA) was charged with administering a very comprehensive law, called the Federal Water Pollution Control Act Amendments of 1972. The act provided for controlling water pollution from any source.

EPA's first task was to set up a permit system to provide for effluent limitation for all point sources of discharge. These include sewage treatment plants, industrial waste plants, and other similar sources. The system has been implemented and is now working effectively.

Another portion of the law deals with nonpoint pollution sources. Nonpoint sources are those where the pollution does not originate directly from a pipe but is a result of some activity such as construction,

excavation, or forestry practices. Nonpoint sources also can include insidious types of pollution, such as leachate from garbage dumps and underground travel of pesticides and nutrients. We're dealing, therefore, with a fairly complex mechanism and one that isn't easy to define.

EPA was in somewhat of a quandary as to what to do about these, because issuing permits to nonpoint sources of pollution just wasn't practical at the time the Amendments were passed.

The National Resources Defense Council sued EPA and got a court judgment stating that EPA will implement ways to abate nonpoint sources. EPA personnel in Washington, D. C. are now trying to plan ways to do this.

I should describe the EPA responsibility concerning water quality. EPA is really a multiheaded agency. Several of our functions are regulatory. We also have technical and educational functions. We have the largest public works budget of any federal agency, for the construction of sewage treatment plants. EPA has a very large research function. In Alaska, about 20 persons work in the Arctic Environmental Research Laboratory at College and another 10 are here in Anchorage, so we're pretty well staffed in Alaska.

Water quality may be defined in two ways. In its regulatory role, EPA defines water quality very legalistically. When issuing a permit to a particular discharger, we define water quality in a permit, saying that he will not discharge sewage if, for instance, it contains a concentration of more than 30 parts per million of suspended solids.

From a technical standpoint, however, what does water quality mean? It means different things to different people. The person who drinks water has one perspective of water quality. Fish might like to live in a certain quality of water that is unpalatable to people. Esthetics--the visual appearance of water--is important to some people; the quality for industrial or agricultural purposes is quite different.

Each of these is defined in the Alaska State Water Quality Standards. For example, dissolved oxygen is very important to fish. It might be less important to people who drink that water. These criteria are legally defined, and the State, through its water quality standards, has a strong regulatory function.

In its treatment of nonpoint source pollution that may result from surface disturbance, EPA does not now have regulatory functions. While the question of whether or not we can issue permits for nonpoint sources is decided back in Washington, EPA's chief emphasis at controlling this pollution source is through planning grants to state agencies.

The Amendments provide that basin plans will be prepared by each state. In Alaska, the State expects to have 11 plans prepared by June

30. Through these plans, they hope to obtain much-needed data which will enable the state and local jurisdictions to control nonpoint source pollution. Section 208 of the 1972 Amendments specifically addresses itself to nonpoint sources; that is, those areas that cannot be issued permits as point sources.

As part of the planning process, after the state plans have been submitted to EPA, they will go out for public review. The mechanisms for defining, data gathering, and controlling nonpoint sources of pollution will be open to public inspection and comment. Anyone who is interested in a specific aspect of water quality can express his interests and get them into the state planning process.

Some of the nonpoint sources of pollution that can be permitted by EPA include placer mining permits here in Alaska. In other states, we have issued permits for feedlots and irrigation return flows. These could be defined as nonpoint pollution sources, but they can be controlled through the permit process.

Another aspect of the Federal Water Pollution Control Act Amendments is that they require each state to revise its water quality standards every three years. Water quality standards have many local criteria and can be controlled much more effectively at the state level than at the federal. Alaska is getting close to the time when it must review its standards. I expect that some nonpoint source aspects will be addressed during this review.

Although the title of my talk is "water quality," I should mention that surface protection involves EPA in another matter, air pollution. One of the worst air pollution problems in the State is right here in Anchorage. This is from particulates caused mainly by disturbance of the surface. Paving more roads, minimizing disturbance in vegetated areas, and similar remedies will probably have to be administered at the local level, either through ordinance or by land-use policies.

Although land-use legislation is not popular in Washington, D. C., EPA is working with state and local jurisdictions to emphasize that land-use planning is really the best way to control nonpoint source pollution. Proper land use is probably the most important single factor in pollution control.

session eight

CHAIRMAN: James V. Coan, General Engineer
Division of Resources
Bureau of Land Management
Alaska State Office
Anchorage, Alaska

SURFACE PROTECTION--continued

--continued on next page.

Equipment Development--continued

Proposed ORV Regulations

Helen Nienhueser

ABSTRACT
Although it brings some benefits, especially in rural Alaska, off-road vehicle use on public lands managed by BLM and the State Division of Lands must be regulated to reduce damage to the surface and such natural resources as wildlife and vegetation, to prevent vandalism to remote cabins, and to keep ORV use from conflicting with nonmotorized uses. Regulations should begin with closure to all ORV use on public lands until trails and suitable areas can be identified and a permanent zoning plan for all uses developed. Simultaneously with the closure, certain lands should be opened on an interim basis where ORV use for transportation and subsistence hunting is important. Permits could be given for ORV use on prohibited lands if conditions warranted. Two areas that could be zoned for ORV use are highway rights-of-way and airport property. While it is difficult to enforce regulations, including those requiring driver licensing and vehicle marking, the problem is not insurmountable.

Although I am a board member of the Alaska Center for the Environment, I am not specifically representing the Center today. I think that what I will say does generally represent the views of the nonmotorized recreational user of public lands, and I have discussed this subject in depth with a number of people. My remarks, however, have not gone through a formal review by the Center board.

I am very aware of the positive benefits of off-road vehicles and of their perhaps somewhat unique position in Alaska's transportation picture. I asked Mr. Coan to mention my background as a homesteader and owner of a remote cabin built with the help of an ORV to emphasize that I am not just a city idealist whose only experience with Alaskan backcountry is an occasional cross-country ski trip. I've lived there. I've owned and driven four-wheel drives, and I know the need for use of ORV's for transportation in a country with few roads. I also believe that to be happy in Alaska, it is important to enjoy some outdoor winter sport, and I know that snowmobiling has gotten a lot of people outdoors in the winter who would otherwise never get out. I'm sure it is just as effective an antidote to cabin fever as skiing. ORV's are also a vital part of the subsistence lifestyle of many rural Alaskans.

I do believe, however, that the use of ORV's on public lands needs to be regulated. I hope that BLM and the State can work together to come up with a consistent approach. I know this will be difficult because BLM takes its orders from Washington, but I would urge that Alaskan BLM officials make an extra effort to try.

It is important that any regulations devised apply equally to all users. It would be wrong to restrict the hunters' use of a Weasel but allow a miner free rein. The State has the authority to regulate all users equally on state lands, but I am not sure that BLM does. Executive Order 11644, which directs federal land-managing agencies to develop ORV regulations, does give BLM authority over ORV's used for recreation purposes, but whether this authority extends to those used for mining is unclear to me. The proposed BLM regulations, developed under Executive Order 11644, specifically exempt vehicles used to explore or develop public lands for minerals. This exemption is a serious flaw. It poses a legal question which perhaps can only be resolved by Congress through passage of the BLM Organic Act or revision of the 1872 mining laws. At any rate, within their respective legal frameworks, I would urge BLM and the State to be as consistent as possible.

The need for regulation of ORV's has been amply demonstrated by some of the slides shown during this seminar. Without doubt, unregulated summertime ORV use is unnecessarily damaging the land. I'm sorry that BLM's excellent slides of the mining road being built in the Strelna area between Chitna and McCarthy were not also shown. Other examples of damage caused by recreational vehicles can be found in the Lake Louise and Nabesna areas.

Closer to home there is the motorcycle trail in the north fork of Campbell Creek, just outside Chugach State Park, on military land. A trail, originally cut by a homesteader, leads from the Campbell tract up above timberline onto the flanks of Knoya. From there, motorcycles have cut scars across the alpine tundra in all directions. This is strictly recreational use, and in my opinion, it is a level of damage which is totally unnecessary and completely unacceptable. I would like

to know why the Department of Defense is not controlling this kind of use.

Resource damage by snowmachines in the winter is less obvious. The slides shown earlier of the lemming grazing do document the claim that snowmachines have an effect on small animals. There may also be negative effects on large animals; a BLM study in 1971 in Idaho concluded that deer and elk struggle to keep a 1/2 mile buffer zone between themselves and unseen snowmachines. They run, often uphill, as far as four miles to escape the roar of machines. This undue exertion and stress drains limited winter energy reserves. Without the stored fat needed to survive until spring, animals are left to die of starvation, exposure, or disease. Undue stress may also cause a pregnant female to abort or resorb her fetus, and make animals unable to respond to other stressful situations including attack by predators.

Other studies show damage to vegetation. When air spaces in snow are compacted, the insulating capacity is reduced and vegetation which usually weathers the winter cold under a blanket of snow is subjected to abnormal extremes of temperature. In a test done in Minnesota in '71-'72, the coldest air temperature was -43.3 degrees C. Under undisturbed snow, the temperature one inch above ground was -6.2 degrees C; under snowmobile-compacted snow, the temperature at the same point was -19.8 degrees C; two inches below the ground the temperature under undisturbed snow was -1.9 degrees C; under snowmobile-compacted snow it was -10.7 degrees C. This study compared alfalfa growth in an undisturbed plot with growth in plots crossed by snowmobiles various numbers of times. The alfalfa growth was definitely less in the snowmobile-compacted snow; however, weeds and undesirable plants increased their growth.

Since we are talking about regulating uses on public lands which are in natural condition, the effect on alfalfa is not of particular significance to us. The test does indicate, however, that there is an effect on vegetation, and I wonder if we know enough about the effect on Alaska's various forms of natural plants to say that there is no damage to vegetation from snowmobiles.

Another reason for the need to regulate ORV use is the increase in vandalism to remote cabins. ORV's, especially snowmachines, make cabins that used to be left open to use by anyone very vulnerable to theft and damage. The movie, "Sourdough" made this point rather dramatically. We need a mechanism to identify the machines and the drivers and to control who uses the machines.

I value my individual freedom as much as anyone. I don't want to be told where I can hike or ski or camp or build a fire. I can sympathize with the ORV user's desire to continue to be able to operate his machine wherever he wishes. But I have two comments on the freedom argument. First, there are times when two freedoms conflict and then a collective choice has to be made as to which freedom must be curtailed. In all

aspects of our lives in Alaska today, we are now experiencing such a conflict between freedoms because of the increase in our population. When there are very few people, their impact on the land is minimal. For example, the first and second Pug traveling cross-country leave no mark. The tenth Pug across the same route is traveling on a trail. The 50th Pug is going to have to make a new trail in some places because the original trail is too soft. And a Pug is one of the least damaging summer ORV's.

The freedoms that are conflicting here are the freedom to have as many children as we wish and the freedom to move wherever we wish in the United States versus the freedom to do whatever we wish on the public lands. We can't have both; either Alaska's population has to be limited or we will have to accept some regulation on our use of public lands. I don't like the situation, but I do not see any alternative to accepting the regulation. Because of Alaska's increase in population, the level of damage and of conflict between uses are both now at a point where regulation is required. The old Alaska we all liked so much is gone. Our task now is devising the best possible approach to preserving what is left in terms of both scenic and wilderness values and lifestyles, while at the same time remembering that some kind of continuing economic base is necessary and that development of at least most of our mineral resources is at some point inevitable. Reasonable regulation of ORV's is one part of preserving what is left of what we like about Alaska.

The second point I'd like to make about the freedom argument is that it is impossible to compare a motorized activity such as snowmobiling with a nonmotorized activity such as cross-country skiing. Snowmobiling and ORV use generally are intrusive activities. Because of the motor noise, they intrude upon anyone within a quarter of a mile or so. In a quiet winter mountain valley, the effect has a much broader range--perhaps on others within three to five miles.

Cross-country skiing and snowshoeing are quiet and affect no one but the individual pursuing the activity. So we cannot put skiing on one side of the scale and snowmobiling on the other and expect them to balance out. They simply cannot be compared. Those who use snowmobiles have chosen a sport which is different from other winter sports because it is noisy. They should not expect equal freedom for their sport with quiet sports which bother no one. True freedom carries with it a recognition of the rights of others and responsibility for those rights. All of us should have a right to quiet.

There is an important distinction to be made here, one that has not been made by all the seminar participants. I am not advocating regulating <u>the people</u>; I am advocating regulating <u>the activity</u>. Jack Helms and Paul Berry have every right to go anywhere the cross-country skier or hiker goes, but they should not be able to take their ORV's all those places.

What form then should the regulation of ORV's take? The first and most important recommendation is that all public lands should be considered closed to off-road vehicle use. Trails and areas which are determined to be suitable for ORV use can then be opened for such use.

Before the roof falls in on me, let me hasten to explain some thoughts on implementation of this and also some reasons. First, implementation: because of the important use of ORV's for basic transportation and subsistence hunting purposes, any such closure would have to be simultaneously accompanied by an interim reopening of substantial areas where ORV's are used for these purposes. This would be primarily in areas around roadless villages. To a large extent, any closure of public lands to ORV use would not affect lands around villages since most such villages are largely Native and lands around the villages will be under private ownership. There are some exceptions to this, however, and other cases where public lands are close enough to villages to be within ORV range, particularly snowmobile range, and where hunting on these public lands with ORV transportation would be important to subsistence users. Some interim provision for recreational uses could perhaps also be made.

When I speak of public lands, I am specifically referring, at the moment, to lands under the management of BLM and the State Division of Lands. A closure of public lands to ORV use by BLM and ADL would not affect recreational ORV users in such places as the Chugach National Forest and Chugach State Park. I'm told by several people who are very familiar with the State, including rural areas, and with ORV use statewide, that areas could be chosen for interim reopening with about a day's map work.

A permanent zoning plan for motorized and nonmotorized uses could then be developed. A mandatory completion date for such a plan is probably desirable to assure that such decisions are not indefinitely postponed.

This zoning should be done on the basis of location, time of year, and type of vehicle. The capability of the land to withstand ORV use should be a major criterion. In some areas there would probably need to be little restriction on the use of lightweight, low-pressure recreational vehicles such as the Pug, Coot, or Cushman's tractor. Such vehicles as the Penguin, four-wheel drives with conventional tires, Weasels, and swamp buggies are more damaging, however, and would be subjected to greater restrictions, i.e. there would be fewer areas open to them. In many cases, summer ORV use would probably be confined to existing trails, after determination of their adequacy, or to trails established for ORV use rather than being permitted to travel cross country randomly.

Another criterion for zoning should be separation of conflicting uses. Time of year would be a factor--some trails are okay in hunting season but not in breakup. Disturbance of wildlife would be a factor--

areas that Alaska State Department of Fish and Game wants to limit to walkin hunting should be closed to all ORV use.

If an area is closed to ORV use and someone needs to cross it for a particular purpose, he should be able to get a permit to do so from the land managing agency. Obtaining such a permit should not be guaranteed, but it should be possible unless there are very good reasons against it. Most terrain can sustain one or two passes of a low-pressure vehicle at the right time of year. It is the repeated passes that are the problem.

Two areas that I'd like to see open for snowmobile use, at least selectively, are highway rights-of-way and airport property. I am aware of the safety problems, but they don't exist in all cases. These are areas where there is already a high noise level and in that sense, snowmobile and motorcycle use is compatible. Where highway rights-of-way and residential use are adjacent, snowmobiling is inappropriate. But where they are not, and the safety problems can be eliminated, why not have ORV use there? Perhaps it could be handled by the ORV groups petitioning for use of particular rights-of-way and pieces of airport property, and of the State Highways Department and Division of Aviation granting such use after inspection of the specific site. The burden of proof regarding lack of conflict and safety hazards could be on the ORV groups.

Another question to be considered is how we should determine when to open areas to winter snowmobile use. On the Kenai Moose Range and in Chugach State Park it's done by announcement when the land manager determines that there is sufficient snow. This doesn't seem practical for such a large, far-flung area as that under combined BLM and ADL jurisdiction. The only alternative would be to specify snow depth and make it the responsibility of the snowmobile operator to be sure that the snow was the proper depth. The problem with this is that in some places four inches is adequate and in others three feet is necessary to cover young trees. There isn't an easy answer, but I don't think it is an insurmountable problem.

A major argument against the "closed-until-open" approach is difficulty of enforcement. Admittedly, it would be difficult, but not so difficult as to cause us to throw out this approach. Four or five years ago the City of Anchorage made the same protests about unenforceability. They banned snowmobiles in response to public pressure and today, winter life in the city has improved immeasurably. I never see a snowmobile. This has happened because most people, now that they know what the law is, obey it. Others obey it because there has been some enforcement. While the City is, of course, a more confined area where enforcement is easier, much the same can happen on public lands.

Our two basic goals, to prevent resource damage and separate conflicting uses, will be a long way toward accomplishment if the law-abiding 90 percent of the ORV users obey the regulations. The other 10 percent

will have to be dealt with, at least initially, on a spot-enforcement basis.

Stiff enough penalties, widely publicized, even though administered only occasionally, will serve as an effective deterrent. Confiscation or sale of illegally operated machines is probably the most effective penalty. Perhaps a warning and fine for the first time and confiscation and sale the second time would be reasonable. Fish and Game personnel, Department of Natural Resources and BLM field staff, as well as State Troopers, could be used to enforce the regulations. One of the biggest arguments is that if you have the regulations you can use them when violations become flagrant. The occasional car doing 80 on a lonely stretch of the Seward Highway isn't likely to be bothered by the police. The car that does 80 in the middle of Anchorage isn't going to go far.

What is the argument for adopting the closed-until-open approach? It is basically a moral one. The ORV user, by operating a noisy machine that conflicts with other uses and that has or can have damaging effects on the public resource, land, is creating the problem. Therefore, the burden of proof to show why and where he should operate his machines should be on him. A closed-until-open approach to the public lands requires that a case be made for each area or trail open, placing the burden of making a case where it belongs, on the user.

There are a few other regulations that I would propose. Some of them would make the enforcement job easier. First of all, all ORV's, not just snowmobiles, should be registered annually. The registration number should be prominently displayed and should be four or five inches high. The larger vehicles should have numbers twelve to eighteen inches high that can be read from the air. This provision for registration and marking should be enforced. The registration number should also be attached to the tread of snowmachines in such a manner as to leave an imprint in the snow. The amount of the registration fee should vary depending on the size of the machine and its potential for damage; large machines such as the Penguin, Weasel, and swampbuggy should pay perhaps as much as $50 to discourage their use. These funds should be earmarked. They should not go into the general fund. In part, they could be used for administrative costs, in part to restore areas torn up by ORV's, in part to develop ORV trails--perhaps covering soft spots or bridging streams at problem points on existing trails.

Operators of ORV's, including snowmobiles, should be required to have a license or be operating under the direct supervision of a licensed adult. The minimum age for a license should be 16 years. A condition of the license should be passing a test that demonstrates knowledge of the ORV regulations and good operating practices. I know this is restrictive, but my goal is to insure a reasonable level of responsibility in ORV operators. We own a cabin in the Matanuska Valley with some friends. It is alone on a lake so it is an attractive destination. We have had repeated acts of vandalism and I suspect it is mostly by kids on motorcycles

and snowmobiles. This may be an urban problem and licensing at the age of 16 may be an undue hardship in the Bush. Perhaps operating an ORV on private property, i.e. Native-owned lands, should not require a license. Perhaps another way to achieve responsibility in ORV operators would be to make the registered owner of the machine responsible for anything done by anyone operating the machine, but I don't think this would be as effective.

I concur with Sam that vehicles operating on public lands should be required to meet a noise standard not greater than 72 decibels at 50 feet.

ORV regulations should include a provision to discourage abandoning machines on public lands. Once a vehicle has been registered, an annual fee should be required until the owner certifies in writing that it has been disposed of in a satisfactory manner. If a vehicle cannot be removed from public lands without unreasonable difficulty, a fee could be paid for the privilege of disposal on the public domain and disposal certification then completed.

In conclusion, I'd like to re-emphasize that I recognize the benefits of off-road vehicles, especially to Alaskans. In many cases, I think an ORV trail and an ORV is preferable to a road. I hope that responsible ORV owners will join with nonmotorized recreationists to support a reasonable program of regulation. An ability to identify the vehicle positively and therefore place the blame for misuse on the specific offender will protect the responsible owners. It is very important that any kind of zoning recognize and provide for legitimate nonrecreational users, and also provide substantial areas for recreational use where such use can take place without damaging the surface.

A Recreation User's View of the need for Federal and State Regulations and Permits

Virginia dal Piaz

ABSTRACT
The conflict between conservationists and ORV recreational use is basically one of conflicting values. Regulations on public lands should recognize man's need for noise-free solitude. Production capability and affluence have accelerated ORV recreational use, however, and excessive noise, harassed wildlife, injured and destroyed vegetation, trail and streambank erosion, and litter have accompanied this use. Noise is an environmental pollutant that can also create human health problems. Snow compaction and exhaust elements from ORV's have been shown to damage vegetation. While nonmotorized recreationists can enjoy wilderness experiences without intruding on others, motorized users cannot venture into the wilderness without bringing the mood of the city with them and destroying peace and quiet.

The main conflict between conservationists and recreational users of ORV's arises basically from different sets of values pertaining to resource use and recreational experience. A value can be defined as "a principle, standard, or quality considered worthwhile or desirable--something prized or esteemed." I think it would be safe to assume ORV's are not highly valued by environmentalists.

If our public lands, held in trust by the Forest Service, Bureau of Land Management, National Park Service, and Fish and Wildlife Service are

to be managed for the benefit of <u>all</u>, then it would be a very limited recreation policy that neglects man's need for places to refresh his life and sense his identity with other life and the earth. Most of these types of places, to have the greatest value, must be free from the shattering influence of incompatible machines.

We are familiar with environmental effects of the car in its traditional setting--traffic congestion, highway construction, noise, air pollution, junkyards. Add to this vehicles that can go off the roads--and a host of new environmental problems evolves. <u>All</u> of these are difficult to solve.

What is the long-term value of ORV use to a person's health and outlook as compared to that from self-propelled recreation such as hiking or skiing? This would be very hard to quantify because a conservationist would approach the subject by comparing his preference for quiet to motor noise, for clean air to motor exhaust, and for a natural panorama to one filled with machines.

On the whole, ORV's were not too popular until about 15 years ago when production capability and affluence converged and ORV's became the "thing to do." Their use has, even in such a short time, impaired natural values and traditional recreational pursuits. Their use is associated with excessive noise, harassed wildlife, injured and destroyed vegetation, trail and streambank erosion, and litter.

Although ORV's are used some for law enforcement, research, surveying, utility work, lumbering, and ranching, a 1970 survey by the Upper Great Lakes Regional Commission of snowmobile users revealed that trail riding accounted for 47 percent of all use and "other pleasure" for an additional 40 percent--the nearest other figures were hunting and fishing 8 percent, required transportation 3 percent, and racing 2 percent."

Some brief comments about several things that concern conservationists--noise and vegetation effects.

Noise is an environmental pollutant. It used to be confined to the city--but no longer. Its intrusion into formerly nonmotorized country creates new annoyances for anyone who seeks privacy and rural quiet.

Acceptable noise limits range from 73 decibels at 50 feet (equivalent to vacuum cleaner at 10 feet) to 50 decibels at 50 feet, according to Dr. L. Glascow, Assistant Secretary of the Interior, speaking in 1969 at a seminar, "Snowmobile Today."

Paradoxically, while an off-road vehicle operator may want the freedom to enjoy a quiet scene, he also enjoys making noise. Whether running a tractor, lawn mower, motorcycle, or snowmobile, many operators enjoy the sense of power that noise signifies.

This phenomenon may explain why ORV's are not quieter. One industry representative put it this way: "These machines could be half as noisy with a little extra cost, but they wouldn't sell--the American male just does not want a quiet snowmobile." But to be fair, the American male has not yet had much choice in the matter.

Complaints about off-road vehicle noise are frequent. The impact of noise is by no means limited to mere nuisance, however. Noise plays a part in creating the stress conditions that contribute to such ailments as ulcers, hypertension, and coronary disease. It should be noted, however, that individual reactions to noise vary widely. Other studies show reactions of vasoconstriction, high blood pressure, effects on adrenals, ovaries, and kidneys, and stress reactions (Geber and Anderson 1967).

By the same token, an off-road vehicle noise which would pass unnoticed in a city becomes a tension-producing irritant of the highest order to someone who has made a deliberate attempt to get away from the urban din.

Erosion, devegetation, and trail littering are typical effects of the use of ORV's, especially in the summer when there is no snow to protect the ground cover.

Probably the most comprehensive study made of snowmobile damage was conducted by Dr. Wallace Wanek of Bemidji State College in Minnesota. He studied the effect of snow compaction from snowmobiles on temperature, microbe content, and vegetation of the underlying soil, as well as the effects of the vehicle on larger flora and wildlife.

Specific study conclusions suggest that unrestricted snowmobile use carries the potential for significant environmental damage. For example, temperature data strongly indicate that snowmobiles drastically alter the physical environment under the snow wherever they travel. Under natural snow cover, soil temperatures rarely fall much below the freezing point, whereas temperatures under snow compacted by snowmobiles were as much as 11.5 degrees colder. Soil microbe data, though scanty, suggest that bacteria and fungi may be adversely affected by snowmobiling. Under compacted soil of a snowmobile trail, the number of bacteria were reduced at least a hundred-fold and the fungi two- to ten-fold, when compared with corresponding microbial counts under natural snow cover. The potential damage by snowmobiles to young coniferous trees and other woody species is high.

In U. S. Forest Service booklet, Air Pollution and Trees, it is pointed out that many of the constituents of internal-combustion-engine exhaust may damage trees. Classes of exhaust pollutants that may, in significant concentrations, cause injuries are ozone, peroxyacetylnitrate (PAN), ethylene, oxides of nitrogen, ammonia, and particulates. These elements are usually dispersed. When an inversion layer or topographic features restrict dispersion, pollutants may remain trapped in localized

pockets with potentially serious results. Effects of the various pollutants on trees differ, but in general they involve defoliation, flower injury, yellow leaves, and abnormal growth. Air pollution may retard growth and at the same time make trees more vulnerable to attack by various insects and diseases.

Conflicts are inevitable between off-road vehicle proponents and more traditional outdoorsmen. Consider: ORV operation can spoil the pleasures of hiking but the reverse is rarely true. ORV's make nature "easy." In order to save the beauty of wild places and intact landscapes, it ought to be difficult to get there. Machines make it too easy. In addition, machines transfer the mood of the city (speed, noise, light, traffic, air pollution) to the country. "One of the most valuable aspects of outdoor recreation is the peace of mind and restoration of spirit that comes from the separation of man from his normal noisy environment" (Harrison 1971).

The impact of ORV's on recreation involves the physical presence as well as noise and effects on fish, wildlife, and vegetation. A recreation policy must weigh the various cultural, historic, esthetic, and wilderness values that provide an increasingly rare form of recreation against intrusion by motor vehicles.

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The Moccasin Track

W. Victor Lancaster

ABSTRACT
Canadair Flextrac Ltd., since 1972, has designed, developed, and tested a low ground pressure, smooth-track system to reduce surface damage by tracked vehicles. This system, named the "Moccasin" track, is covered by United States and Canadian patents. This paper deals with the prototype design, development, and testing; prototype test results and field service reports; surface damage effects of the Moccasin track relative to the standard tundra flat track; response of the use operator and environmental agencies; and description of the latest preproduction track shortly to undergo testing in the Inuvik area. This preproduction design incorporates wider belts, rubber folded belt edge protectors, and a grouser and sprocket configuration developed specifically for the Moccasin track. These design improvements have improved the already worthwhile surface protection characteristics of the tundra flat tracks and the prototype Moccasin track by lowering ground pressure. Use of folded belt edge protectors reduces the possibility of track edges slicing beneath or through vegetation.

Perhaps I should expand a little on the Canadair Flextrac name. A lot of you don't recognize it until you hear the name Nodwell added to it. Apparently, our vehicles are still known as Nodwells, no matter what name appears on the front of the cab.

The vehicles I am discussing in this session are in the medium range,

the CF, that is Canadair Flextrac, 110 and 160. The 110 is a sprung vehicle; the 160 has a walking beam suspension. Gross vehicle weights are in the area of 30 to 40,000 pounds. A couple of other words you will hear me use, particularly in reference to tracks, are D-Dent. That is a grouser or track bar that looks like the drawing on the board with a deep dent in the middle of it. You will hear me talk about flat tundra tracks. In the order of evolution, they followed the D-Dent. The flat tundra track is a reasonably aggressive track, although developed for tundra use, in that the grouser bar is still a formed channel. You can see the tundra track on the comparison diagram (Fig. 1).

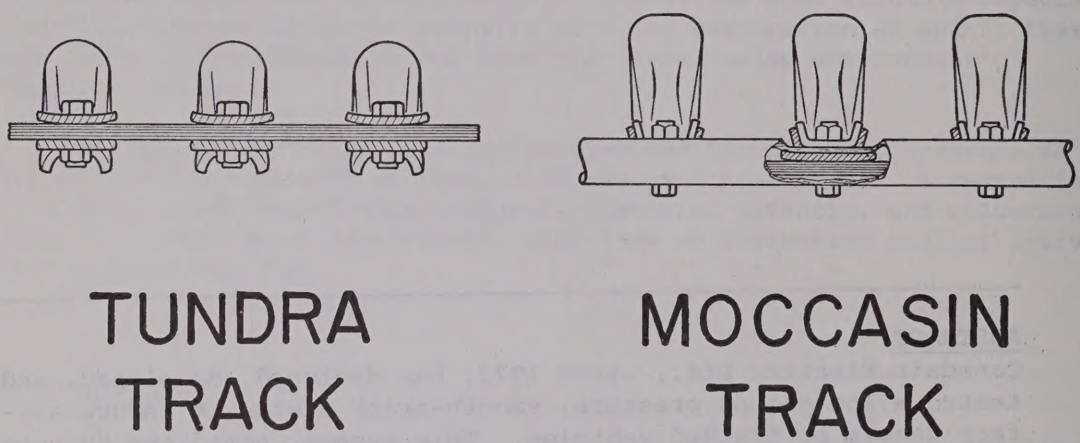

Fig. 1. Comparison of the Tundra and the Moccasin Tracks.

Since this is a Surface Protection Seminar and this session is the "Current State of the Art for Industry," it is obvious that we are interested in that part of the vehicle that touches the ground. Over the years, Canadair Flextrac has undertaken several quite significant track studies, not only as routine research and development but also special studies, some funded by the Canadian Government. The growing concern for the surface damage caused by what was the general purpose D-Dent type of track and our own continuing studies have resulted in the development of a smooth track system which reduces surface damage by our tracked vehicles to a reasonable minimum and yet retains low ground pressures. The most recent design improves upon ground pressure and also maintains reasonable traction. This new system has been christened the Moccasin track for fairly obvious reasons and is now covered by both Canadian and American patents.

We have built two sets of these tracks. The first one was the prototype and is still in service. After preliminary testing at Calgary in the summer of 1972, the track was shipped to a Gulf Oil seismic camp near Inuvik, where it was tested on a CF160 vehicle with a drill mounted and

operated by Kenaston Drilling.

The first production set of tracks is currently here in Anchorage and belongs to the Canadair Flextrac distributor, Karl Holfeld & Associates, Inc. If anybody wants to see the system, he should make arrangements with Karl Holfeld, who is attending the seminar this morning. We hope to continue tests with these tracks this spring and summer, unless Karl sells them, in which happy event we will build another set.

The subject of this paper is a very brief outline of the test program conducted around Inuvik in 1972-73. The results of this program encouraged us to pursue development of the track.

The prototype looked very much like the diagram titled "First Generation Moccasin Track" (Fig. 2).

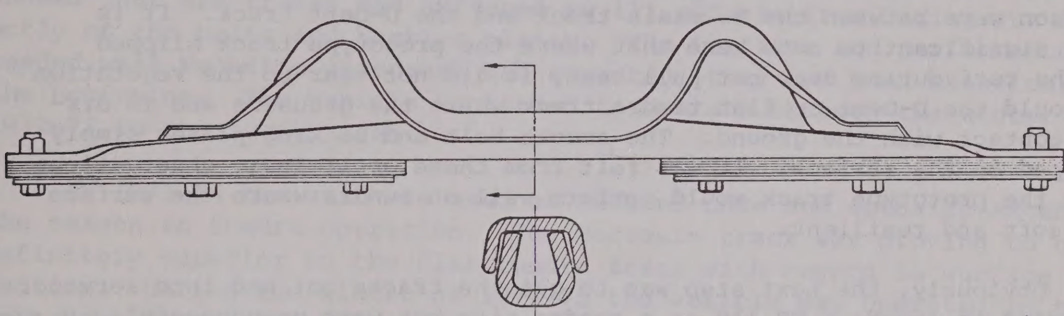

Fig. 2. Moccasin Track concept--first generation.

It incorporates a flat grouser bar and a formed wheel guide, very similar in concept to our regular flat tundra track except that the track belt is on the bottom of the grouser; therefore, it contacts the ground directly. For the prototype build, we used existing stock guides and bars with spacers added so that the desired configuration could be achieved. The aim was to retain the tundra sprocket for use with the new tracks. One Moccasin prototype track and one flat tundra track were mounted on a CF 110, and the vehicle was run on our test ground in Calgary. At the conclusion of the test, we fitted two prototype tracks to this vehicle. We got better than expected draw bar pull results, with a draw bar pull to gross vehicle weight ratio of 67.5 percent. This is only 10 percent less than the tundra track system with its fairly aggressive grousers.

The vehicle with these first generation Moccasin tracks was a little difficult to steer on hard surfaces and on side hills. In later tests, steering was found to be no problem on the softer terrain of the tundra or in snow.

During the draw bar pull tests it was noted that the buckling observed with regular tracks under tension loads on the ground was not evident. Two factors contribute to this: 1. A more even distribution of tractive forces over the track surface occurs as opposed to point loading of grousers in the D-Dent configuration; and 2. The twisting moment or couple from the ground thrust line to belt centre is very small.

The prototype track did not appear to uproot vegetation as much as a tundra track, especially in the centre of the grouser. Also, the grouser pressure imprint in soft soil is barely discernible compared to the imprint of a tundra track grouser. After the tests it was observed that more rapid revival of the vegetation occurred where the experimental track had traveled than where the tundra track had traveled. These differences, of course, would have been even more dramatic if the comparison were between the Moccasin track and the D-Dent track. It is also significant to note here that where the prototype track slipped on the turf during draw bar pull test, it did not tear up the vegetation as would the D-Dent or flat tundra track where the grousers are in direct contact with the ground. The smooth belt and backing plates simply slipped on the surface. It was felt from these preliminary observations that the prototype track would perform well on tundra where the surface was soft and resilient.

Obviously, the next step was to get the tracks out and into service. We tried to locate a CF 110 on a tundra site but were unsuccessful. Finally, however, we found a CF 160 owned by Kenaston Drilling and they were willing to install the tracks for us and put them to use.

The vehicle was not the best vehicle to demonstrate the new track system, since the ground clearance was very low and the vehicle was fitted with a drill rig which caused the vehicle to be loaded heavily to the rear and to travel somewhat rear end down.

The tracks were transported in August of 1972 to the site, adjacent to Peter Lake, north of Inuvik [Northwest Territories], where the terrain is generally dry and hilly. The active layer varies from 10 to 20 inches and is very soft, with some outcroppings of rock on top of hills. The weather during the three days of these tests was alternately sunny and overcast, with rain and fog each day.

The CF 160 had a Cummins 478 Diesel engine with a Fuller 5-speed manual transmission. A Holemaster drill was mounted. The estimated weight was 36,000 pounds, with a nominal ground pressure of 3.3 psi. The tracks were installed with no problem.

Tests indicated that very little impression was left on the tundra. Sinkage was about 3 to 4 inches when the vehicle was traveling. Cutting occurred when the edge of the track rose over the edge of a hummock, but in general, only compression took place. There was very little breakage

of small plants, and the trail remaining was difficult to pick out because of the limited damage. On hills or side slopes the trail became more evident, but this was due partially to the rear-heavy configuration of the vehicle and the power required to climb. Occasionally on a climb, the front road wheels were clear of the ground, and there was excessive sinkage in the rear. It was noted, however, that after the vehicle passed up any sort of slope, the surface mat was not chopped up. In some areas, however, pieces of mat were displaced rearward.

One significant deficiency occurred, however, during the tests. On sharp turns and occasionally on some side hills, the track cut sideways into the tundra mat and turned over quite large chunks of soil and vegetation.

Subsequently, the operators of the CF160 reported that no operational difficulties that could be attributed to the track were encountered during the summer tests. The vehicle was returned to Inuvik, and examination showed that the tracks had suffered no ill effects from having run directly on the belts and backing plates. The traction and performance exceeded what Kenaston personnel had expected; they had been skeptical at the beginning. The vehicle continued to operate through the winter of 1972-73 in the Inuvik area.

In 1973-74 the unit was used at Parsons Lake and actually extended the season in tundra operation. The Moccasin track was proving to be definitely superior to the flat tundra track with regard to surface protection. During the winter of 1974-75 the vehicle was operated in the Fort McPherson and Arctic Red River region in the foothills of the Richardson Mountains. The track had been reported as good in level snow and ice, probably as good as the D-Dent track. Also, under certain conditions, the vehicle with the Moccasin track outperformed a CF110 equipped with D-Dent tracks.

Let's now take a look at the next set of tracks to be built. Primarily, we eliminated some of the prototype hardware, spacers and so on, and eliminated about 1400 pounds of weight. Next, we incorporated a feature which we had been looking at for awhile; we made the track asymmetric. This means that we had an uneven width of track on each side of the wheel in order to narrow the overall width of the vehicle so that it could be loaded into a Hercules aircraft without removing the tracks.

Another important consideration that became evident was that this track was going to need its own sprocket. This was considered unfortunate because it made the kit for the conversion of old models a little more expensive than had been anticipated originally.

Another problem was how to eliminate the damage to the terrain during sharp turns, that is from the track edge digging into the surface. To resolve this problem we incorporated a curled edge belt that presents a radiused contour to the terrain. Belts about 5 inches wide are curled

to a "C" shape and bolted to the track by the outer edge track bolts. Figure 3 shows these edge belts in position.

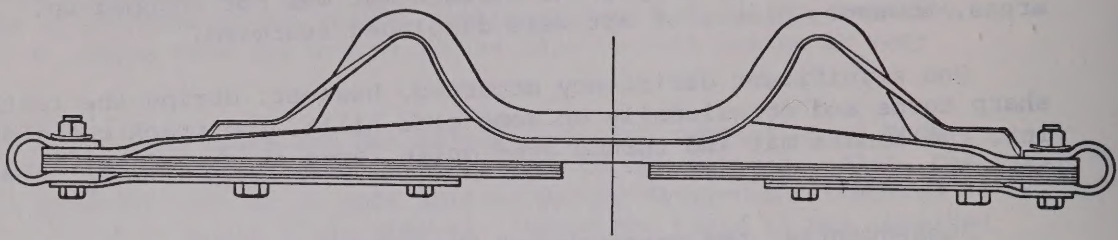

Fig. 3. Asymmetric Moccasin Track concept--second generation.

This production track also incorporated a change in the belt width. To decrease ground pressure, the belts were made wider, narrowing the gap in the centre of the track where the wheel and the sprocket run. As a result of this change, the belts now cover approximately 90 percent of undersurface of the track, virtually eliminating any grouser contact with the ground.

A vehicle set of these production tracks was built and installed on a CF110. This set, as I mentioned earlier, is in Anchorage and may be examined at Mr. Holfeld's place of business. Unfortunately, the tracks are not installed on a vehicle.

The general reaction to the Moccasin type has been very favourable. Problems experienced with the prototype included broken wheel guides and cracked grousers, generally the type of thing that can be expected because the track is a "cobbled-up" prototype. The belt has stood up very well.

In conclusion, I may say that the Moccasin track is superior to any other track that has been put into use, from the aspect of minimizing surface tundra damage. Further testing is necessary to establish the merits of the curled edge belt. It adds a fair expense to the original cost, and under certain terrain conditions may prove to be unnecessary.

The year-around operator needs only a few hours to add to the Moccasin track an ice-pick system which enables him to use his vehicle on ice and improve its performance on hard surfaces. These ice picks have actually been installed and have been proven in use, so the Moccasin with ice picks brings us full circle to yet another general-purpose track system.

Sufficient testing has been completed to indicate that the Moccasin track can be used year around in tundra, snow, and ice with only marginal

loss of traction characteristics that does not significantly reduce vehicle mobility. The system becomes available for virtually any of the vehicles produced by CF or its corporate forebears - Robin Nodwell, Nodwell, Flextrac Nodwell - any of these vehicles which carries a 40-inch track. The proviso is that in installing the new Moccasin track on an older vehicle, the user must also purchase the sprocket to suit the new track configuration.

I would like to thank you very much for inviting CF to participate in your seminar, and I will now be happy to answer your questions.

ORV's : Environmental Effects

Robin T. Harrison

ABSTRACT

Off-road recreational vehicles (ORV's) have been the subject of considerable controversy because of their effects on the environment. These effects may be broadly classified into four areas--noise, air pollution, water pollution, and ground disturbance. This paper deals briefly with the effects on the environment of the three most popular classes of ORV's--motorcycles, snowmobiles, and all-terrain vehicles--in these four areas, with emphasis on the fourth, ground disturbance.

No research has been done that shows that noise from any of the classes of off-road vehicles studied and reported on in the literature is harmful to any aspect of the environment. Noise, however, causes considerable annoyance to nonmotorized users of the environment, particularly recreationists.

Although air generally is affected very little by off-road vehicle exhaust, it has been hypothesized that local toxic effects occur. Although the author is not aware of controlled research in this area, a theoretical investigation of this hypothesis is presented.

Water pollution presents a somewhat different story. Outboard boat motors of a two-stroke design are known contributors to water pollution, and some jurisdictions are considering requiring the use of biodegradable oils. The environmental effects of the use

of such oils in ATV's is discussed.

Probably the severest adverse environmental impact from use of ORV's, particularly in Alaska, is that of ground disturbance. A brief review of basic ground disturbance theory is presented. The fundamental assumption that energy input is proportional to damage is discussed, and the two main mechanisms of soil damage, compaction and shear, are briefly alluded to. New theoretical work that relates the traction coefficient-slip curve and the concept of squirm energy to soil disturbance is also briefly touched upon.

Studies done with snowmobiles yield conflicting results; some conclude that compaction under the snow is damaging to emergent plant life; others hold that little shear-type soil damage is seen from snowmobile use.

Motorcycles and all-terrain vehicles, however, present a different story. Compaction damage can be controlled through operator training, as can shear damage to a certain extent, but currently designed power trains for both motorcycles and all-terrain vehicles can lead to significant shear energy input to the soil, with resulting damage. Optimum design of tires for motorcycles and all-terrain vehicles to be used on Alaskan soils is discussed.

Finally, examples of some novel all-terrain vehicles, both disastrous and innocuous from an environmental point of view, are given.

Off-road recreational vehicles are a subject seldom approached without preconceived biases. Those of us who don't like 'em, don't like 'em. We know that they're noisy, smelly, unhealthy, antisocial, and environmentally destructive. On the other hand, those of us who do like them like them just fine; spend most of our extra money buying them and our extra time working on them, selling them, and polishing them, and on an occasional rare, good day, actually riding them around in the great outdoors.

Off-road vehicles (ORV's) that I will discuss today are of the three most popular classes of this relatively recent and uninvestigated phenomenon--motorcycles, snowmobiles, and all-terrain vehicles, or ATV's. As a visiting expert who must maintain at least an appearance of scientific impartiality, I will withhold comments on the sociological and policy aspects of off-road vehicles and constrain my talk to the measurable, researchable effects of these three classes of vehicles on the four areas we most generally think of when we think of "environmental pollution"--noise, air pollution, water pollution, and ground disturbance.

Noise

No research exists which shows that the noise from any of the classes

of off-road vehicles under discussion is harmful to any aspect of the environment. The noise does, however, cause considerable annoyance, particularly to nonmotorized users of our lands. In the slides, we see an off-road motorcycle and a snowmobile undergoing noise tests.[1]

Rather extensive research by the Forest Service has indicated that the noise generated by all three classes of ORV's can cause permanent hearing damage to the operator. How, you ask, can a noise source loud enough to cause permanent hearing damage to the operator not be a serious environmental problem? Distance from noise source to listener's ear is the answer. At 75 or 100 feet, current snowmobiles are measured at no more than 80 dBA, not much louder than normal conversation.

To my knowledge only snowmobile noise has been systematically investigated. Research concludes that snowmobile noise does not significantly disturb the two species investigated, deer and rabbits. In short, they acclimate rapidly to the noise. When they are disturbed by snowmobiles, it is probably the physical presence of the snowmobile and its operator rather than the noise that causes the disturbance. I personally have seen deer come running to the noise of a chain saw, which probably sounds to them much as a dinner bell does to you. I have also seen rabbits carry on, as rabbits do, with truly remarkable consistency and fertility in the large grass areas between the runways at Los Angeles International Airport, surely one of the noisiest locations in the world.

In summary, noise from off-road vehicles seems to be a problem for only one species of animal--Homo sapiens. I certainly do not mean to minimize the ORV noise problem in regard to this animal, but merely to indicate that the rest of the natural world seems largely indifferent to how rackety we are.

Air Pollution

Air generally is affected very little by off-road vehicle exhaust. Compared to other sources, man-made and natural, ORV's are miniscule contributors. No evidence exists that ORV exhaust contains poisons toxic to any phase of the biosphere in the minute concentrations that they are found.

It has been hypothesized that local concentrations may be increased dangerously by concentrated ORV use. The most often mentioned possible problem in this area is the introduction into the biosphere of heavy hydrocarbons from two-stroke engines which use an oil/gasoline mixture as fuel. Assuming a very rich fuel-oil mixture of 24:1, a ridiculously low economy of 7 miles per gallon, and an oil droplet fallout over a

[1]Because of printing limitations, color slides used by Mr. Harrison in his seminar presentation are not reproduced here.

strip only 20 feet wide behind the ORV, a single off-road vehicle would deposit one quart of oil over roughly 4 million square feet of the terrain. In reality, concentrations are probably two or three orders of magnitude less than this. So we see that air pollution from off-road vehicles is really trivial.

Water Pollution

Water pollution can present a somewhat different story, at least with reference to boats, because most of the oil effluent is deposited on a very finite stratum, the surface of the lake upon which the boats are operated. Outboard boat motors of the two-stroke design are known contributors to water pollution, and some jurisdictions are considering requiring the use of biodegradable oils. Of the vehicles we are discussing today, this would seem to be a problem only with ATV's, and then only if they are used extensively in still, inland waters. In any event, several companies are working on commercially available biodegradable oils to answer this problem. My own feelings with regard to ATV's is that this type of water pollution is negligible. Water pollution due to accelerated erosion caused by off-road vehicles is also a possibility, but this phenomenon is best considered as part of surface disturbance impact to be discussed next.

Ground Disturbance

The severest adverse environmental impact caused by the use of off-road vehicles, particularly here in Alaska, is that of ground disturbance. In order to discuss ground disturbance of ORV's intelligently, we must look to research conducted on other types of vehicles. As far as I know, very little research has been done on recreational ORV's. A good deal of excellent literature has been written, however, on the terrain mechanics of industrial vehicles, automobiles, and trucks.

In order to apply these data to the ORV, however, an understanding of some basic ground-disturbance theory is necessary. I see you shifting nervously in your seats. As one who has difficulty balancing his checkbook, I can share your disquiet, and I assure you that I will present you with absolutely no mathematics.

The fundamental assumption that we must make is that soil damage is proportional to energy input into the soil. This is not hard to visualize if you think about it for a moment. The soil is a structure-oriented community. By this I mean that arrangement of the soil particles is as important to the plants and animals who live there as such gross descriptors of the soil as average pH, nominal class, and sieve analysis. This is a basic truth late coming to the scientific community. Engineers have a habit of thinking that rolling the soil is great: this compacts it, makes it harder; you can drive a truck on it without hurting it. Agronomists, on the other hand, throw up their hands and say that when you roll the soil, you squash and shear our tender little roots. This controversy

is one that is not likely to abate in the foreseeable future.

Energy input to the soil can take two forms--shear and compaction. Compaction is just what it sounds, the squashing down of the soil surface. Think of the soil as a layer of soft, fluffy snow. You will see that its structure is irreparably altered by making it into a snowball, even though the chemical composition and grain size are not altered. This is compaction damage. Compaction is generally thought of as being in the direction normal to the soil surface plane.

Shear, on the other hand, is slippage between strata or particles in a horizontal plane. It's easy to see how excessive shear in the soil can also do irreparable damage, particularly when you consider the fragility of many of the root structures and microflora and fauna living in the soil.

There is one other basic theoretical consideration that I have to bother you with if you are to understand soil damage; that is, whenever a tire rolls over a surface there is some slip. That's right, no matter how gently you start from a stop sign, you are slipping your tires. Whenever you turn a corner, no matter how sedately, slip is increased. Without this slip, or "differential velocity" as we call it here, no force would be generated.

Fig. 1 shows the coefficient of friction between the tire and the ground surface as a function of the differential velocity between the two for blacktop, gravel aggregate, and sand. As you can see, the coefficient of friction is zero if the differential velocity is zero; thus, no force can be generated. Note that for up to a coefficient of friction of about .3, the curves for sand and blacktop are identical. Although the gravel and sand curves show increased slips and develop low peak Mu values, the sand curve shows an interesting natural lockup of the sand particles. If we compare these three curves, we see that the sand curve rises initially almost as deeply as the blacktop curve until higher shear stresses loosen the sand and induce the characteristically higher slip throughout the remainder of the sand curve. Now let's turn to specifics.

Shear damage caused by snowmobiles traversing snow-covered terrain is negligible. Compaction of the snow itself can be a problem, however, as can compaction of the soil beneath it. The insulating properties of snow and vegetative debris produce subsurface soil temperatures which are progressively warmer and which fluctuate less with depth. Soil temperatures under the compacted snow are colder, however, and change more quickly.

Careful observations during some rather extensive studies indicate that the growth of most early spring plants was retarded under snowmobile trails. On one alfalfa patch, four snowmobile trips over the same path, however, did the same damage as 11 snowmobile trips. The control areas--no snowmobile travel--had better alfalfa and fewer weeds, while the snow-

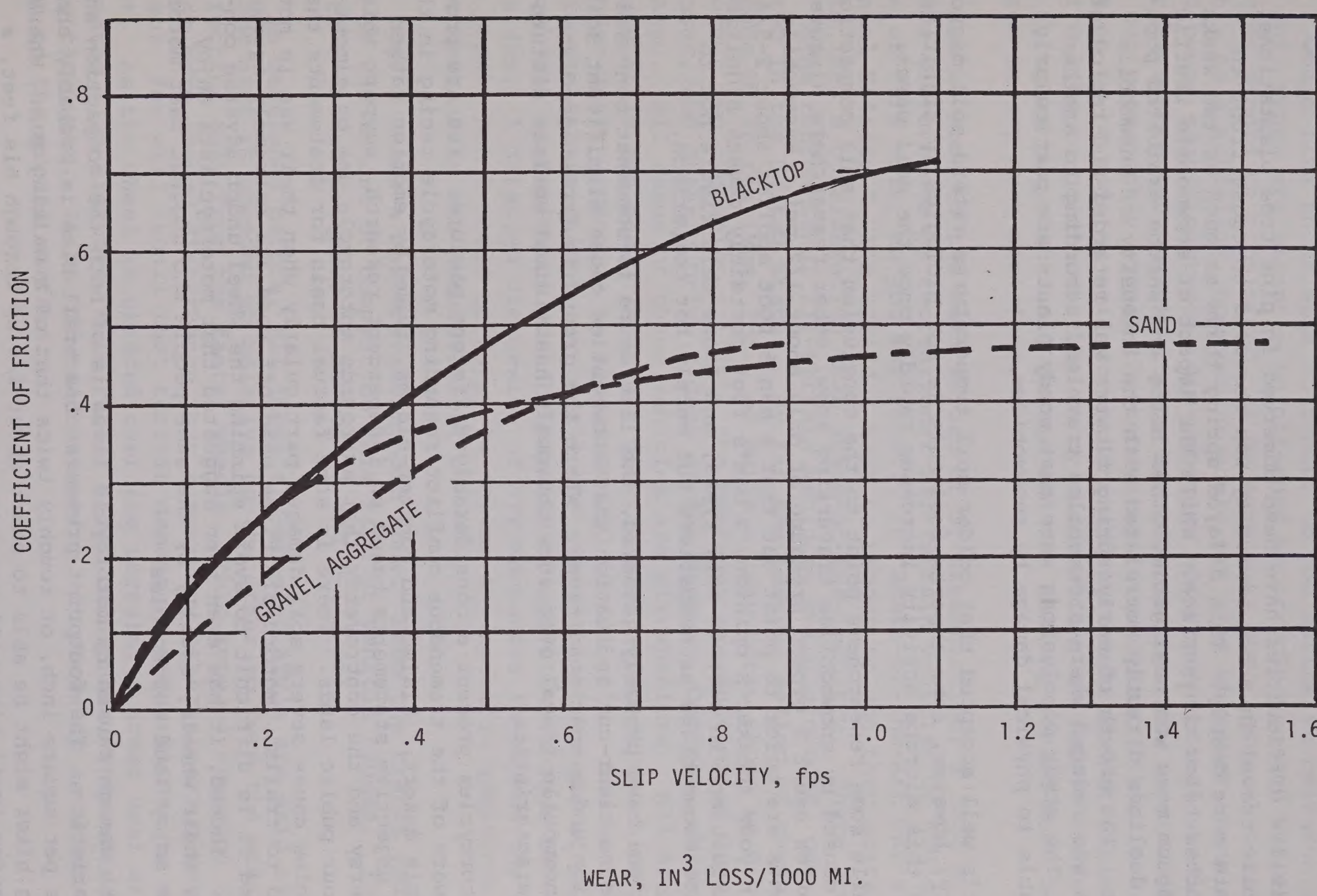

Fig. 1. Coefficient of friction between the tire and the ground surface as a function of the differential velocity between the two for blacktop, gravel aggregate, and sand.

mobile-compacted areas were about 25 percent less productive.

Similar difficulties have been observed in pine tree plantations. Snowmobile travel in a bog community was observed to cause frost to penetrate more deeply. This delayed spring thaws as much as two weeks at 6 inches below the surface. While the impact of snowmobile traffic on sphagnum moss was negligible, other herbs and shrubs exhibited population declines directly correlated with the intensity of snowmobile traffic. The growth of early spring flowers was retarded and reproductive success was reduced where snowmobiles traveled, according to another study. The study conclusions were that woody plants are particularly vulnerable to physical damage by snowmobiles.

It's well accepted that colder soil temperatures retard soil microbe activity; however, some experts feel this is not biologically significant because this microbe activity increases rapidly once the soil warms.

While some researchers point to the conclusion that soil compaction is not caused by snowmobiles traversing snow, other researchers disagree. Snowmobiles exert a ground pressure of only about 1/2 psi. Snowmobile proponents are quick to point out that a man's foot applies about 2-3/4 psi. In your speaker's opinion, a man's foot certainly causes significant soil disturbance in certain soil types, and I use this figure not to exonerate snowmobiles as compactors but merely for comparison.

As you have probably gathered, the literature is somewhat confused. There is no clear-cut indication that snowmobiles cause significant soil compaction under most conditions. Where the ground is frozen good and hard, snowmobile travel over snow obviously has minimal surface disturbance characteristics.

Motorcycles present a considerably different picture. You are probably aware of the tremendous conflict regarding motorcycle racing in the California desert. Claims and counter-claims, fueled by emotion rather than by objective statements based on independent research, support this controversy and the controversy that surrounds motorcycle use on almost all of our public lands. There is some factual basis for statements that motorcycles cause severe soil damage, particularly when their use is not confined to trails. Motorcycle tires used off road are extremely aggressive, and it is difficult to avoid spinning the wheel under adverse conditions. Indeed, it has even been suggested that motorcyclists enjoy spinning their wheels, usually by the same people who suggest that motorcyclists enjoy loud motorcycles.

Soil damage caused by motorcycle tires is of both the compaction and shear varieties. The footprint pressure of a trail bike is probably about 6 pounds per square inch, or roughly twice that of a walking man. Whereas a strong hiker might be able to exert about 1/4 hp through his feet, a good running trail bike will generate as much as 100 times this figure. I am not suggesting that soil damage is proportional to power available,

but if we accept the basic premise that energy input to the soil is proportional to soil damage, the potential for great soil damage is easily seen.

I would like to be able to report to you extensive research as to what soil types are amenable to off-road motorcycle use and where such vehicles should be prohibited. I am sure that such research does not exist. As a guideline, however, I would say that wherever a man walking would cause significant soil disturbance, motorcycle travel should definitely be restricted, unless it has determined that local soil damage will not permanently impair the ecosystem in question. This is a determination to be made by soil scientists and agronomists, not engineers, but I'd like to point out that to my observation, at least, there is no such thing as permanent soil damage and the healing period must be considered in any such decisions.

Now we come to the main thrust of my presentation; a look at possible surface disturbance by recreational all-terrain vehicles or ATV's. The title of this talk, as you may recall, is "State-of-the-Art ORV's: Environmental Effects." I'm afraid I have to report to you that state-of-the-art is less a consideration than state-of-the-industry. There are currently only three recreational all-terrain vehicles being produced, one in Canada and two in the United States. By far the largest seller of these is the Max made by Recreatives, Inc., of Buffalo, New York, shown in Fig. 2. The other two companies still in the business are Hustler of Jonesboro, Arkansas, and Ontario Drive & Gear of New Hamburg, Ontario, which builds the Argo. All three of these vehicles are six-wheelers. All are powered by snowmobile engines. These are generally of a two-stroke single or twin cylinder design, ranging in size from 290 to 440 cc's. The heart of the ATV is the transmission. Since all the six-wheel ATV's are of skid steer design, the transmission must be capable of splitting torque between the two sides. A detailed discussion of ATV mechanics is beyond the scope of this paper, but I would be happy to answer any specific questions that you might have after the presentation.

Fig. 3 shows a Max traversing old snow. From the tracks you get some idea of the amount of compaction this kind of vehicle causes. This ATV exerts a ground pressure of between 1 and 1-1/2 psi.

As mentioned before, all these six-wheeled ATV's are skid steer; that is, one side is speeded up relative to the other to turn the vehicle in a direction away from the faster wheels. This type of steering necessarily causes more ground disturbance than almost any other steering methodology. Why so? You will recall that terrain damage is proportional to energy input. As the wheel is skidded over the terrain, a great deal of energy is wasted. On highways, with rubber tires on asphalt, this energy shows up as tire wear. In an off-road situation, it shows up as shear energy input to the ground surface.

Fig. 4 shows typical six-wheel ATV tire sitting on a level, flat

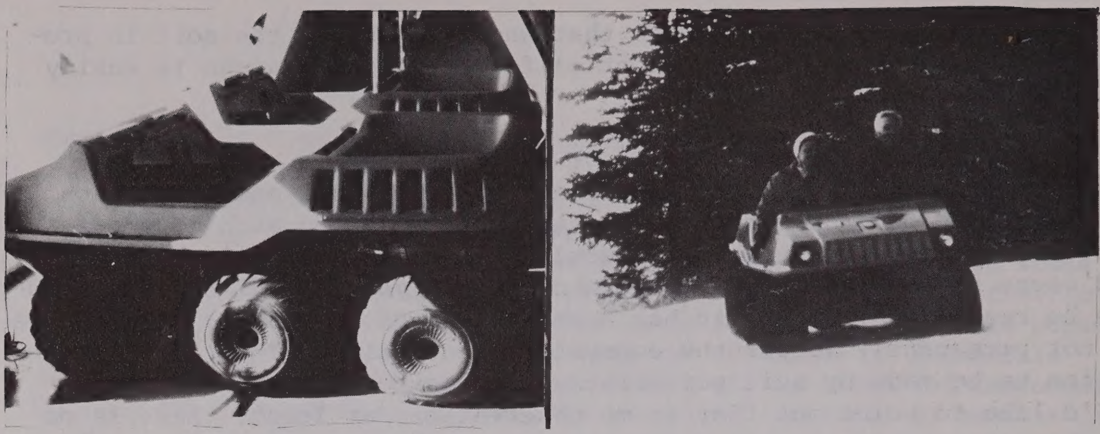

Fig. 2. (left) The Max, a large-selling recreational all-terrain vehicle. Fig. 3. (right) The same vehicle traversing old snow. This ATV exerts a ground pressure of between 1 and 1 and 1/2 pounds per square inch (psi).

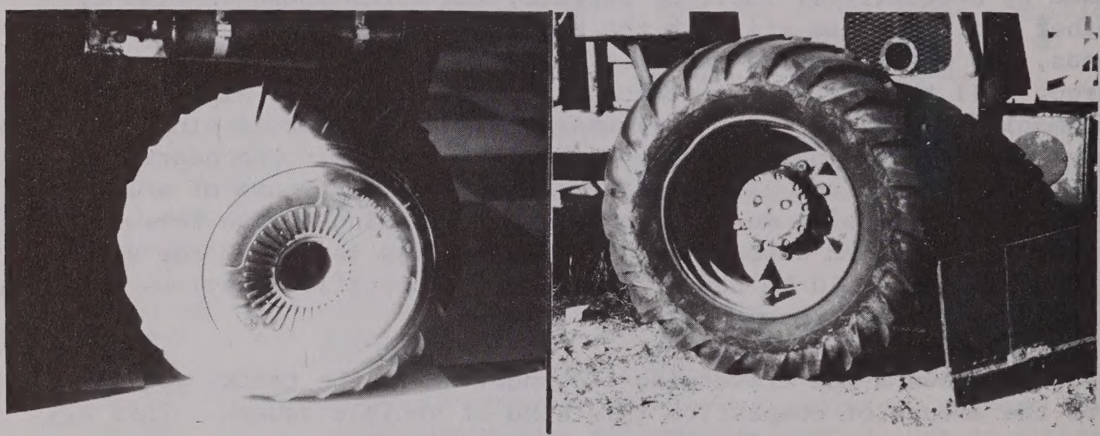

Fig. 4. (left) A typical six-wheel ATV tire on a flat, level surface. Note its similarity to the heavy treaded tire in Fig. 5. (right)

surface. Notice its ominous similarity to the one shown in Fig. 5. Protagonists of the large balloon ATV tire will tell us that the low pressures minimize ground compaction. This is, of course, true. But what is often ignored is the fact that shear, which may be much more damaging than compaction, is increased as tire pressure is decreased. Why is this? Because of the mechanism of squirm shear. As the tire greets the earth's surface, it deforms from a toroidal shape. To do this it must move laterally as well as longitudinally, and the various elements of the tread, as they contact the surface, must move relative to each other in both of these directions. Thus, energy is wasted, and this waste energy shows up again, as shear damage to the soil.

The concept that an ATV tire must look like a trenching tool is probably one engendered more by advertising copy than by sound engineering thought. Let me quote from Henry Hodges of the Nevada Automotive Test Center in comments regarding winter tires: "So called winter tires are a relatively recent nomenclature for tires that appear to be more aggressive than winter is slippery. In the past, this emphasis on aggression produced tires that were uniquely noisy, unstable, rough riding, and unsuitable for any mode of motion except excavation." The same thought is applicable to all-terrain vehicle tires.

Look at the ATV balloon tire in Fig. 4 again. The lugs that you see there are not effective for anything except swimming, where they are necessary. You will note the rest of the carcass is completely smooth without any trace of siping. Sipes, or small slots, to allow water to escape, are quite necessary to prevent hydroplaning, which can occur at very low speeds with such a fat, lightly loaded carcass as we have here. Indeed, hydroplaning can occur even when the vehicle is stationary if the tire is spinning.

Look at Fig. 6. The advertising sign that you see on the seat of the Thunderchief says 35 hp, 45 mph. Anyone who has ridden such a vehicle at 45 mph can attest to the fact that the longitudinal stability is poor. For any off-highway vehicle of a given ground contact area, the length of the footprint is more important than the width. Longer, more slender vehicles waste less energy than wide ones, especially in soft terrain. This means that more of the engine's horsepower goes into driving the vehicle forward and less shows up as soil damage. Therefore, we would like to make ATV's as narrow as possible. But, a skid steer vehicle must be fairly stubby for the skid steer system to work, and the narrower a skid steer vehicle is, the more of its tractive effort is wasted during turning maneuvers. These two conflicting basic needs, that of narrowness for efficient terrain ability and width for efficient turning, would seem to mitigate against skid steer all-terrain vehicles.

I would like to leave you with some thoughts as to how surface disturbance might be minimized with current and future ORV's.

With current vehicles, it seems that snowmobiles don't cause much

Fig. 6. While this ATV can travel at 45 mph, longitudinal stability of such vehicles at that speed is usually poor.

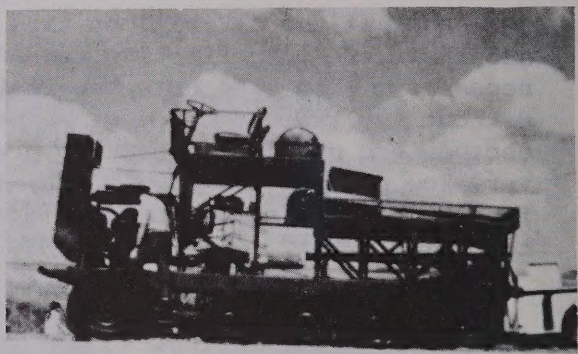

Fig. 7. A Florida Everglades half-track which has a very low-pressure footprint. It is owned by the Florida Department of Fish and Game.

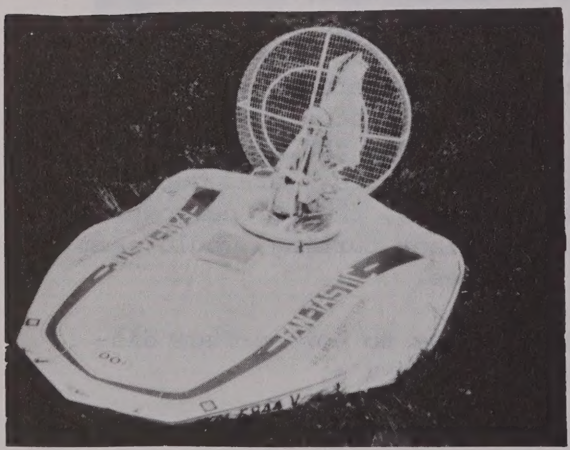

Fig. 8. A novel approach to reducing environmental impacts--an inflatable surface-effect vehicle powered by an 8-horse power garden tractor engine.

ground disturbance as long as they are operated on snow. Motorcycles should probably be limited to nonfragile soils. Current all-terrain vehicles present an interesting challenge to the land manager. These vehicles are capable of excellent payloads and excellent maneuverability over soft soil types. The soil damage potential is considerably less than that of conventional four-wheel drive vehicles. Nonetheless, in certain soils these vehicles can cause significant damage. For current generation vehicles, one way to avoid damage is to train operators. Wheel spin should always be avoided. Operators should be instructed not to run back and forth in the same track, to prevent compaction damage. Large radius turns, which, of course, involve less wheel skid than tight turns, should be encouraged. Tire pressures should be maintained at manufacturer's recommended figures, and if the vehicles are to be used on dry fragile soils, tire pressures should be increased somewhat.

Finally, what about the future designs? In my opinion, the limitation of the skid steer system, described above, will limit the amount of reduction in soil damage potential that current concept ATV's might achieve. An articulated steer system, such as that used on some of the larger industrial vehicles, would both improve maneuverability and decrease soil damage potential.

Beyond this, differential velocity sensors which would limit wheel spin would certainly have a salutary effect on the ground damage picture.

Looking beyond six-wheeled vehicles, I'd like to explore very briefly some alternate ORV concepts. Fig. 7 shows a Florida Everglades half-track. I believe it was developed by the Goldberg Engineering Corporation, but if you can believe it, this monster is owned by a governmental agency, the State of Florida Department of Fish and Game. Despite its ungainly appearance, the vehicle has a very low pressure footprint. I introduced this to bring to you once more the thought that the ecosystems upon which we drive these vehicles are different. Rather extensive research in the Florida Everglades has shown that some well-used half-track trails vanished within 6 or 8 months from the time use was discontinued upon them, while others have lasted as long as 25 years since closure. Here we have at least a 50:1 healing time ratio. The unraveling of this mystery, I am happy to say, is in the hands of biologists and not us engineers.

Fig. 8 shows a novel approach--this is called Fantastic. It's an inflatable surface-effect vehicle powered by an 8-horsepower garden tractor engine. It's quite as equally at home over not too rough terrain and water. Barry Palmer of Palmer Aerosystems in Renton, Washington, developed this vehicle. It has been engineered to minimize all environmental impacts including noise. I am quite impressed with this design. It is inexpensive, efficient, quiet, carries a good payload, and should have wide application once put into production, particularly here in Alaska.

Special Equipment for Mined Land Reclamation

Don Calhoun

ABSTRACT
The Surface Protection Specialist in the Bureau of Land Management Denver Service Center is concerned mainly with mined land reclamation. He works with various other groups that are developing equipment for reclamation. The Kentucky Reclamation Association, a nonprofit, private association of mining companies, pools specialist staffs, equipment, and has a purchasing program to work with reclamation efficiently and economically. A similar association for surface protection might help solve surface disturbance problems in Alaska. A handbook on surface protection for Alaskan field workers also might be useful.

After a five-year absence from Alaska, I have noticed several changes in just the small area I have visited. Some of these are disturbing, not only to the surface I might add. I recall a conversation, during an earlier visit, with one of the Alaskan old-timers. He was asked, "Have you lived all your life in Alaska?" His answer was, "Not yet." Then, as he rocked in his chair, he added that he'd lived in Alaska a long time and had seen a lot of changes, probably a thousand of them, and, he grumbled, "I've been against every damn one of them."

I want to compliment the BLM Alaska State Office for this program and seminar. I think it's really good, the best I have seen. It is very comprehensive and in my view, it is right on target as to surface protection and the program as I see it. I wish, however, that there were more

participation from our Washington staff.

Earlier in the program, Bill Gabriel said that when they first talked about this program, they intended it to be a small gathering of people working with surface protection. When they considered all the problems involved in all the different surface activities, they found that a much larger meeting was necessary. In this connection, I want to mention that I have attended two annual National Coal Association meetings in Louisville, Kentucky. I was amazed, frankly, that more than 2,500 people registered for these meetings each year. I would guess that about 75 percent of them are concerned primarily about reclamation. These conventions have been held only three years, and I am encouraged that there is so much interest.

My work at the BLM's Denver Service Center deals primarily with mined land reclamation, although I am very much interested in other types of surface protection problems that have been brought out here.

My observations are that mined land reclamation requirements and accomplishments are quite variable. These variations often are related directly to the quality and enforcement of the state laws and regulations. An Alaska reclamation law may be needed to deal with these types of problems, regardless of the land ownership. It might be an effective way to deal with some surface problems.

Today I want to acquaint you with some of the things that are going on down in the Lower 48 and work I do. Perhaps some of these ideas may relate to work you are doing or with modification, may be useful to you.

One group of people I have worked with is the Vegetative Rehabilitation and Equipment Workshop. The Workshop has been rather directly connected with the Range Society and the work the Society does with range rehabilitation equipment. The Workshop is going to meet in Omaha, Nebraska, February 14, 15, and 16 [1976].

One development of the Workshop that has impressed me is the rangeland drill and similar innovative equipment. The group has operated continuously since 1943 and seems to me to be a rare example of excellent cooperation among agencies.

Another group we have dealt with recently is Rob's [Harrison] counterpart in Missoula, Montana--the Forest Service Equipment Development Center. One device they are working on in cooperation with the BLM is a tree and shrub transplanter. Landscape workers have used this type of machine for a long time, but we are examining and evaluating it for possible use in mined land reclamation.

Another machine being developed at the Center is called a mulcher and rotovator. This is used to apply a mulch to mined land soil or spoil material, and a rotovator incorporates the mulch into the upper layer of

soil material.

A machine that I am especially excited about is called a gouger and was developed by a professor at the Montana State University at Bozeman. It creates depressions in the soil that are about 2 feet long, a foot wide, and 6 to 8 inches deep. The purpose is to accumulate and concentrate the available moisture for plant growth.

Another idea from the Forest Service is the possible use of containerized transplanting stock--trees, shrubs, grasses, almost every kind of plant. Workers are experimenting with various types of containers. This is a new field and they don't know many of the questions, to say nothing of the answers. They are starting, however, and I think this is exciting.

We have also discussed with the Forest Service the development of a machine that plants containerized plants automatically. The containers used are about 2 inches in diameter and 10 to 12 inches long so the plants can establish a root system before being taken from the nursery or greenhouse to the mined land site. The Service also has been conducting a systematic continuing search of literature and of equipment company developments.

Last week, we visited two of the four Bureau of Mines Research Centers; one in Spokane, Washington, and the other in Salt Lake City, Utah. In contrast to the Workshop and the Equipment Development Center, where operations are small, the Bureau of Mines seems to have millions of dollars to work with and is putting it to good use. I will describe some of it, but some ideas haven't yet been developed into prototype machines and are just concepts. So you'll have to use your imaginations as I tell you about them.

One machine has back-to-back dozer blades that are hooked with cables to tractors like D-9's. The blades are moved back and forth across rows of mine spoil material to level it more quickly and efficiently than with conventional dozers.

Another machine is called a balanced boom and bucket. It is an arrangement of a big drag line, 40 to 50 yard bucket, with a boom going out each way and a little offset. A cable and bucket operate between the booms.

For dirt moving, a new contrivance uses two D-9 Caterpillars that are locked so that one pushes and one pulls a dozer blade about 40 feet wide. Those of you who are acquainted with dirt moving would find the production of this device really amazing. It can move up to 11,000 cubic yards of spoil material an hour. For a sustained period, it can move 6,000 cubic yards per hour. These are precisely determined figures. They are now developing a machine that will have a 60-foot dozer blade moved by two tractors.

Still another contrivance is a Ray-Go, which is two D-9 dozers side by side, with a 24-foot blade and only one operator.

They are also experimenting with self-propelled scrapers whereby an auger arrangement inside the bucket operates vertically and picks up the dirt from the bottom of this can. It speeds loading, reduces friction, and also increases the yardage that can be moved.

A set of gauges has been developed and installed on the panel in front of the bulldozer operator. The gauges show him the relative efficiency with which he's operating the machine. As you know, if the blade is put in too deep, it stops the tractor; if it's too high, it moves fast but doesn't push much dirt. Use of these gauges increases the production of the conventional dozer from 11 to 22 percent.

Another concept involves a large dragline type machine, 50 to 80 cubic yards, that is used to remove overburden in mined areas. It lifts the dirt and dumps it in a hopper, which feeds a conveyor belt. With this contraption, the operators can distribute material evenly at almost any combination of distance and elevation. I think it has good application potential in our mine areas.

A concept that I want to mention may not be applicable in Alaska now, but may be in the future. Last June in Kentucky, I saw an innovative approach to mined land reclamation. It's the Kentucky Reclamation Association, a nonprofit, private association of about 175 mining companies in Kentucky. It is not connected with the state or federal governments or any other agency. A similar association was formed in Ohio. A real advantage of this type of organization is that it concentrates reclamation expertise. The association staff is small but it does the planning, supervision, and the actual reclamation work. The association also concentrates reclamation equipment. This saves member companies the cost of buying their own equipment and hiring operators and maintenance personnel. The association also has a centralized purchasing program for equipment and supplies and maintains a nursery to grow planting stock. An additional advantage of the association is that member companies as a group can deal with state regulatory agencies.

I suggest that an Alaskan off-road vehicle council or association might help solve some of the problems I've heard about during this seminar. Another suggestion for the BLM is that a surface protection handbook be published to get some of these ideas in writing and distributed to the people who are doing the work on the ground.

[Editor's note: The remainder of Mr. Calhoun's presentation consisted of color slides. Because of printing limitations, they are not reproduced here.]

Vehicle for the Future

Charles W. Slaughter

ABSTRACT
The U. S. Army Cold Regions Research and Engineering Laboratory (USACRREL) has evaluated effects of air-cushion vehicles (ACV's) on surfaces on Alaska's Arctic Slope. Most ACV surface impact was from abrasion by the vehicle skirts rather than air flow, which merely removed loose litter. Vehicle speed and surface microrelief both affected surface damage. The ACV damaged the surface less than other vehicles tested and caused less accelerated soil thaw; trails over which the ACV passed recovered faster.

Size, payload, cost, terrain characteristics, and availability are among the conditions that determine the kind of vehicle needed for a particular job. No single vehicle, now or in the future, can fill all the necessary and desirable requirements and cause little surface damage. Other aspects of off-road travel, such as route selection, trail improvement and protection, operator sensitivity, and access priorities also affect surface damage. More important than vehicle design and selection are the management decisions to be made concerning regulation of off-road travel.

Introduction

To start this discussion, a reasonable question might be, "Why is a 'watershed management'-type forester talking about vehicles for the future?" I have the same question. The most plausible explanation may be that I

have had a bit of experience in off-road vehicles, from jeeps and Ski-doos[1] to Bombardiers, Sno-Cats, and Nodwells. I also have had experience in watershed rehabilitation management and research. This makes me an expert in neither mobility nor rehabilitation, but perhaps a few comments from this combined perspective will be useful.

Another aspect of this presentation stems from the fact that my laboratory, The U. S. Army Cold Regions Research and Engineering Laboratory (USACRREL) has been involved for a number of years with evaluation of the surface effects of ACV's--air-cushion vehicles or hovercraft--on Alaska's Arctic Slope.

The ACV is a special class of off-road vehicle. It is expensive, mechanically complicated, noisy, and has high operating costs. But, it is also fast, unimpeded by water or floating ice, and apparently has little direct impact on the land surface. The ACV would seem to have a place, albeit specialized, in northern off-road transport. Thus, as one example of a "vehicle for the future," we will see some film footage of ACV operation in the vicinity of Barrow,[2] followed by a quick recitation of initial results from tundra effects tests. That will be followed by a few comments on off-road transportation for the North.

Air-Cushion Vehicle

In his Monday presentation, Jerry Brown mentioned the results of our ACV trials. In brief, Abele (1975) reported:

1. Most impact came from physical abrasion by the vehicle skirt; disturbance by air flow from beneath the skirt was limited to removal of loose litter. After 50 passes, virtually all loose, dead vegetal material had been removed by blowing air, but there was no apparent damage to live vegetation from air movement. Since most impact resulted from skirt drag, increasing the air gap between skirt and ground surface obviously should result in reduced impact. Similarly, vehicle speed was a consideration--at higher speed (50-65 km/hr) degradation of surface vegetation was more evident than at 16 km/hr. Microrelief was important; the skirt dragged on high points, such as the raised centers of polygons.

2. Abele (1975) also noted that the Rolligon tested (which, it should be noted, had cleated rather than smooth bags) produced heavier immediate impact or damage, for the same number of passes, than did the ACV.

3. As Dr. Brown mentioned Monday, depth of accelerated thaw is an

[1]Commercial or trade names are used for identification only; no criticism or endorsement is intended or implied.

[2]Deleted from the planned presentation during the 22 January session due to the overrun of schedule; shown during the evening of 20 January.

indication of impact and recovery on permafrost terrain. In the Barrow wet coastal tundra setting, a light Weasel caused twice as much or more thaw increase as did the ACV that made the same number of passes. In terms of restoration of thaw depth to near the initial value, recovery took three to five years after Weasel traffic. Comparable data from the 1974 Rolligon trials are not yet available.

4. The visibility of vehicle trails--the "signature"--is another criterion of impact. Abele (1975) found that four years after travel, lanes over which ACV's had made one and five passes were "not visible," while lanes where they had made 25 and 50 passes were "barely visible." Adjacent lanes where Weasels had made 25 and 50 passes were clearly visible after four years.

Vehicle Considerations[3]

Now, let me pass to more general comments about future vehicles.

We seem to be stuck with a few principal ground mobility modes--rolling (wheel and track), sliding (ski and skid), or gliding (air cushion), in addition to walking. All except the air cushion depend on direct ground contact. Wheels and tracks rely upon traction developed by direct friction between the ground surface and the wheel or track and on shear strength of the surface--soil, moss, snow, etc.--with cleats or treads penetrating the surface. Skis and air cushions can be towed or propelled by thrust.

Surface impact can be reduced by the following methods:

1. decreasing ground contact pressure by increasing ground contact area (bigger wheels, longer or wider tracks) or decreasing total weight;

2. decreasing traction dependence on shear and increasing dependence on friction. Examples of this method are the use of smooth, uncleated bags on Rolligons and the "flat track" design tried several years ago on a Nodwell FN-400 at Prudhoe (Burt 1970). (This "flat track," incidentally, is similar to the track design of a 10-year-old, articulated Swedish vehicle which we use in central Alaska.);

3. decreasing traction dependence on friction, by use of aerodynamic thrust or reducing drag of towed loads; or

4. virtually eliminating mechanical contact with the ground, by using air cushions for the total vehicle or components of the vehicle.

These considerations lead us to think about: 1. wheeled vehicles

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[3]Parts of this discussion are based on material supplied by G. Abele, USACRREL, Hanover, N. H. 03755.

with low-pressure tires, i.e., Terra-Tires as used by Canadair-Flextrac and a number of other companies, and the wider, lower-pressure Rolligon concept; 2. tracked vehicles with low ground-pressure and nonaggressive treads, and incidentally, preferably articulated; and 3. air-cushion vehicles or vehicle components.

I. A. Thomas (1975), of Canadair-Flextrac, has summarized several good concepts for off-road vehicles, which relate to some of the above. Thomas emphasized the advantages of wheels over tracks in many situations, though tracks provide the greatest total mobility. He pointed out the potential for increased use of articulated vehicles, both wheeled and tracked. I would suggest that in new vehicle design, articulation may be as important as low ground pressure in reducing vehicle impact and in achieving increased mobility. For six years we have operated with 1964-66 vintage articulated BV-202A tracked vehicles, in central Alaska. The extremely low-level impact I have observed with this vehicle stems both from its flat track and from the articulated steering which keeps power to all tracks during turns (as opposed to skid steering), and thus markedly reduces tearing of the ground surface during turns. More recent experience with lighter, eight-wheeled articulated vehicles has reinforced my impression that both overall mobility--the ability to get there from here--and reduction of surface impact can benefit from articulation. The exceptional performance on snow of the Tucker Sno-Cat, which we also use near Fairbanks, is partly due to its articulated steering between front and rear pontoons.

At this point, rather than get immersed in details of vehicle engineering and ground mobility theory beyond my competence, please allow a bit of wishful thinking about a "vehicle for the future." First, there is no single vehicle, of the present or the future. Size, payload, cost, terrain ability, and availability are among the many factors which call for a vehicle "mix" from which one can pick for a given job. We can list a few attributes which we would like to see in available vehicles:

1. No or negligible ground pressure or signature
2. 60% ± grade ability, 40% ± sidehill ability
3. High axle clearance, but low center of gravity for stability
4. Small size for maneuverability (more important in central and western Alaska than on the open tundra) but with large load capacity
5. Quiet operation
6. Low emission level
7. Low fuel consumption
8. Reliability--low maintenance, good serviceability, and parts availability
9. Reasonable cross-country speed--5 to 20+ mph
10. Operator comfort--adequate leg room, visibility, ride comfort, little cab noise, and cab heat and defrost
11. Low acquisition cost

I know of no ideal vehicle that meets all these requirements. We could add to this list without straining our thinking and still, we are not likely to get one or more rigs that satisfy all our wants. A further complication is that many operators cannot or will not buy and maintain a complete range of vehicles, as from Skidoo and Trackster to Canadair-Flextrac. Rather, they continually compromise reliability vs. speed, load capacity vs. ground pressure, acquisition cost vs. availability and operating cost, and so on. We will all continue, therefore, to be faced with compromises and choices of vehicle based on mission, funding, availability, and a host of related factors as well as on the managerial and regulatory constraints which have been considered in other phases of this seminar.

Related Aspects of Off-Road Travel

It is appropriate to touch on a few other aspects of off-road travel that have not been mentioned or that need re-emphasis:

1. Route selection. Austin Helmers, Larry Knapman, John Stephenson, and others have already discussed route selection in connection with fire control. Traffic for any reason can attempt to avoid the most vulnerable terrain, which in central Alaska can mean streambanks, drainageways, and ice-rich permafrost sites such as alpine tundra, valley bottoms, and north slopes. On the Arctic Slope, this might mean traveling raised beach lines or dry ridges where possible.

2. Trail improvement and protection. Where traffic repeatedly traverses sensitive terrain, such as ice-rich permafrost, even minimal measures taken to protect the organic mat against tearing and to provide surface insulation can mean the difference between erosion and a stable trail. We have successfully used corduroy with native materials, puncheon trail sections of rough timbers, and mats of wood chips to protect and stabilize heavily used trails over permafrost. One problem has been confining traffic to the improved trail sectors--a rough corduroy trail is slower and less comfortable to traverse than the adjacent moss-and-brush-covered frozen silt! Snow roads or work pads can provide seasonal protection to the ground surface.

3. Operator sensitivity. This involves both training and attitude. It applies to recreation, industry, military, and government alike. A heavy foot and disregard for microrelief, vegetation, drainage, and general terrain fragility indicators can result in heavy damage where a sensitive operator might take the same vehicle over the same route with little environmental impact--and with less wear and tear on the vehicle itself. We have all seen or known (or perhaps been) "hotrodders" in jeeps, snow machines, or tracked vehicles. I know of no way to get across this point except through seminars such as this or through individual education and discipline.

4. Access priorities. Regulators or managers must set priorities

for access needs and defend their actions. Is fire control sufficient cause to walk cats across terrain ruled "no vehicles" to the general public? Do military maneuvers justify any and all vehicular movements on military reservations or public domain? Is energy resource exploration important enough to allow cross-country travel in sensitive areas? Should recreational pursuits be allowed motorized ground access, in lieu of expensive aircraft charter, to remote areas? This is probably a familiar refrain to BLM and Forest Service personnel, but a public policy will be increasingly necessary for the populated areas of the state.

Policy Questions

Before closing, allow me to raise a few questions on other concerns which relate to the surface protection theme of this seminar, some of which have been dealt with or alluded to by other speakers. I won't attempt to answer these questions; perhaps some of you have or will.

1. How do the regulations, policies, and management which have been so often mentioned over the past few days mesh with the "real world"--with the landscape, terrain, vegetation, and season? This is really asking how, realistically, do resource managers apply policy to specific real estate--blindly or with cognizance of landscapes and ecosystems, with Aldo Leopold's "land ethic"?

2. How do these same regulations, policies, and management strategies accommodate (a) the available range of vehicle type and impact, both personal (recreational) and industrial, and (b) changing technology (vehicle improvement) and societal demands, such as, hypothetically, a burgeoning availability of low-cost, low ground-pressure ATV's or ACV's on the scale of the snow machine, or of self-powered hang-gliders. (We have in my office right now a proposal to try out motorized touring skis!)

3. Under the rapidly changing, increasingly fragmented land ownership and management pattern in Alaska, what interaction and coordination is there or should there be between managing and owning entities? The ownership boundaries still look like straight lines, not catchment or ecosystem divisions, and rational regulation would call for coordination of policies within and between discrete landscape units.

4. What scale of vehicle and scale of impact is relevant or of major concern? Personal or recreational off-road use seldom entails vehicles of the RN-110 Nodwell class, but may involve literally hundreds of snow machines or motorcycles, as well as dozens of 4x4's or Weasels. Even concentrated horse or foot traffic can be detrimental to land stability and watershed values. Will there be concentration on regulation of recreation, or, conversely, of industry, simply because industry has the big machines that are easy to find and follow and that may have the greatest potential impact from single-pass trips? In similar vein, will single-pass traffic fall under the same policies as repeated trips or "group travel"? Here I'm thinking of the one- or two-vehicle hunting or fishing

party as opposed to the motorcycle or jeep club rally or repeated trips to a mining, exploration, or communications site.

5. Harking back to my initial question, how will the managers, be they federal or state, Native corporation or private landowner, acquire and implement adequate knowledge of the differing physical, hydrologic, and biologic capabilities, vulnerabilities, and responses of the discrete units which comprise the lands of Alaska? Research, in the broadest sense, is and has been providing the basis for this understanding. It is the resource managers, including shareholders, citizens, and advisory boards, who must provide rational implementation of that understanding.

Six years ago, Bob Weeden (1970) wistfully proposed that we retain an Alaska some might still recognize---". . . a place where wolves stalk the strand lines in the dark, because a land that can produce a wolf is a healthy, robust and perfect land. . . a place to stand under a bright auroral curtain on a winter's evening, in awe of the cosmic cold and silence. . . a place where men live amidst a balanced interplay of the goods of technology and the fruits of Nature." Success in retaining even some elements of this Alaska must be based on rational answers to the questions just raised, much more than on any technologically improved "vehicle for the future."

Acknowledgements

The suggestions of Dr. Jerry Brown and Larry Johnson, USACRREL, were most useful in preparation of this discussion. Material on vehicle concepts was provided by Gunars Abele, USACRREL, who also supplied information on his ACV trials. This work has been partially supported by the Civil Works Directorate, U. S. Army Corps of Engineers, under Work Unit CWIS 31003, Watershed Studies in Cold Regions.

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session nine

CHAIRMAN: Ted Freeman, State Resource Conservationist
Soil Conservation Service
U. S. Department of Agriculture
Anchorage, Alaska

SURFACE PROTECTION--continued

Stabilization and Maintenance of Disturbed Surfaces — Page

Stabilization and Maintenance of Disturbed Surfaces

Soil Stabilization

Burton L. Clifford

ABSTRACT

To stabilize soils, their characteristics must be identified. The Vegetative Guide for Alaska presents a special section on soil characteristics. This is designed so an individual can examine a site, determine the soil site group, and custom design a seeding recommendation anywhere in the State of Alaska. The presentation of slides included charts and site examples.

Stabilization and Maintenance of Disturbed Surfaces

Fertilizer Requirements

Dwight Hovland

ABSTRACT

Revegetation helps in stabilization and maintenance of disturbed surfaces.

A combination of conditions yields poor fertility in disturbed soils of the northern environment. Low soil temperatures result in slow chemical reactions and biological decomposition. Under natural conditions, the inorganic pool of plant-available nutrient elements is rapidly depleted through exploitation by vegetation, and the nutrients become stored in the vegetation and organic residues. When this material is removed during surface disturbances, a large reservoir of nutrients is lost. To quickly reestablish a vegetative cover supplemental fertilizer is needed. Some fertilizer elements are required in large amounts because of inorganic "fixation," competition, and other losses.

There are only a limited number of reports from studies that help in choosing the optimum rate of fertilizer for various revegetation purposes.

A convenient reference is A Vegetative Guide for Alaska prepared by the Soil Conservation Service and the University of Alaska, September 1972.

Stabilization and Maintenance of Disturbed Surfaces

Plant Materials and Seeding

William W. Mitchell

ABSTRACT
This presentation treats results of revegetation planting trials conducted along portions of the trans-Alaska oil pipeline route and in the Prudhoe Bay oilfield. It deals briefly with plant materials that can be used in various regions of Alaska on the basis of current knowledge. Further discussion concerns some revegetation-related work conducted with plant materials at the University of Alaska Agricultural Experiment Station, Palmer, and projections on the possible course of future work. Some aspects of natural revegetation also are discussed.

Use of Woody Plant Material in Soil and Site Stabilization and Rehabilitation

John C. Zasada and Alan C. Epps

ABSTRACT
Although woody plants are a dominant part of the Alaskan landscape, there has been almost no attempt to use them for revegetation and rehabilitation projects. This presentation will discuss two aspects of the use of woody plants. First, we will discuss some of the practical and biological considerations necessary to evaluate fully the potential of woody plants in revegetation work. Second, the latest revision of A Vegetative Guide for Alaska, which is now being prepared, contains recommendations on use of woody plants. These recommendations are made by region and soil type. In this discussion, we will present these recommendations and briefly consider their use in planning revegetation projects.

Woody plants are a dominant part of the Alaskan landscape and the various plant communities in the State. Use of woody plant materials for reclamation or restoration purposes, however, has not been the object of intensive research. Rather, it is usually passively accepted that woody plants will eventually return to a site, and little thought is given to encouraging their development. We would like to discuss several aspects of the artificial and natural regeneration of woody plants and attempt to summarize considerations necessary if woody plants are to be used successfully.

Several points concerning woody plants must be made clear. First, they will not replace grasses, either now or in the future. Both types of

plant material are currently or potentially important for revegetation projects. In our opinion, however, restricting revegetation considerations to grasses severely limits the options available to the land manager. In some instances, heavy applications of seed and fertilizer may be detrimental to the attainment of long-term objectives of some revegetation projects (e.g., restoration of native plant communities). To meet a broad range of revegetation objectives, we should consider a continuum of options, ranging from leaving the site in the best condition for natural regeneration to relatively sophisticated systems which incorporate fertilization, combinations of woody plants with grasses and herbaceous plants, and site preparation.

Second, if demand for woody plants were to materialize overnight it would be virtually impossible to begin large-scale use of any but a few of them because of the lack of adequate quantities of seed and transplant material. This should not be interpreted to mean that the knowledge and technology are not available for successful use of woody plants. Information is available from experience in other areas with the same or similar species and, in some cases, similar site conditions. Although transfer of all this information may not be possible, much of it could be used with relatively little modification.

Finally, we must define what we mean by the term "woody plants." Woody plants are those plants which continue to thrive from their aboveground portions from one growing season through the next and longer. In addition, we mean the native plants and to a lesser degree non-native species which appear to be adapted to Alaska.

Why woody plants? Many of the reasons for using native woody plants are obvious and will be mentioned only briefly. Some of the more traditional reasons are that they are adapted to our climatic and soil conditions, they provide a wide variety of shapes, sizes, and colors which blend with adjacent plant communities, they are important browse and habitat for various wildlife species, and they provide year-round esthetic qualities.

A nontraditional reason is that large quantities of energy are necessary to establish and maintain herbaceous exotics (plants not native to the area) (Sutton 1975). Fertilizers are needed to produce agricultural crops, and we feel that use of large fertilizer applications for revegetation must be questioned in light of the need for these materials for food-producing agriculture. In other words, does the use of tons of fertilizer to make a green strip of grass down the middle of Alaska have a higher priority than the use of this material for agricultural purposes? Although we do not know the exact fertilizer requirements for native woody species, we feel confident that they are able to survive and grow under less fertile conditions than exotics, as woody plants do in other areas.

Before one can select materials for revegetation, one must recognize that decisions regarding revegetation and choice of plant materials are

determined by the site conditions and the goals and objectives of the project. The range of sites on which revegetation projects are undertaken is wide and has been discussed by Mr. Clifford and Dr. Mitchell. The point to be made is that native woody plants exist that are adapted to almost every site in Alaska.

The following goals are most commonly given for revegetation programs:

1. Reclamation of the site and prevention of soil erosion.

To meet this objective, a maximum amount of plant cover and root biomass is required in as short a time as possible. Dr. Mitchell has provided us with a great deal of excellent information for grasses. We do not have similar quantitative data for woody plants; however, results of natural regeneration studies indicate that total plant cover can be achieved on the best interior Alaska sites within two to three growing seasons. Woody plant roots may also penetrate more deeply into the soil and be structurally stronger than grass roots.

2. Site restoration or return of the disturbed site to the condition which existed before disturbance.

It is obvious that woody plants are excellent plant materials for this purpose and, in reality, are the only plants which fulfill this requirement over much of the state.

3. Establishment of esthetic and visual requirements on restored site.

Woody plants offer a wide array of color, sizes, shapes, and other qualities for meeting this objective. Evergreen species can provide year-round shielding, and evergreens and other species can provide year-round color contrasts. In fact, woody plants are the only means of providing vegetative screens.

State of the Art in Alaska

The state of the art with regard to the use of woody plants can be considered relative to (1) the availability of plant materials, (2) what is being done to provide more information, and (3) recommended practices.

With regard to availability, a giant step was taken with the establishment of a containerized seedling nursery at the Alaska Plant Materials Center near Palmer. This facility is a cooperative effort between the Alaska Division of Lands and the Division of Agriculture. Production is currently small, but as experience is gained and demand increases, there is every reason to believe that increased production will follow. Growers at the Center are currently producing native tree species, such as white spruce, Sitka spruce, and cottonwood, and exotic trees, such as lodgepole

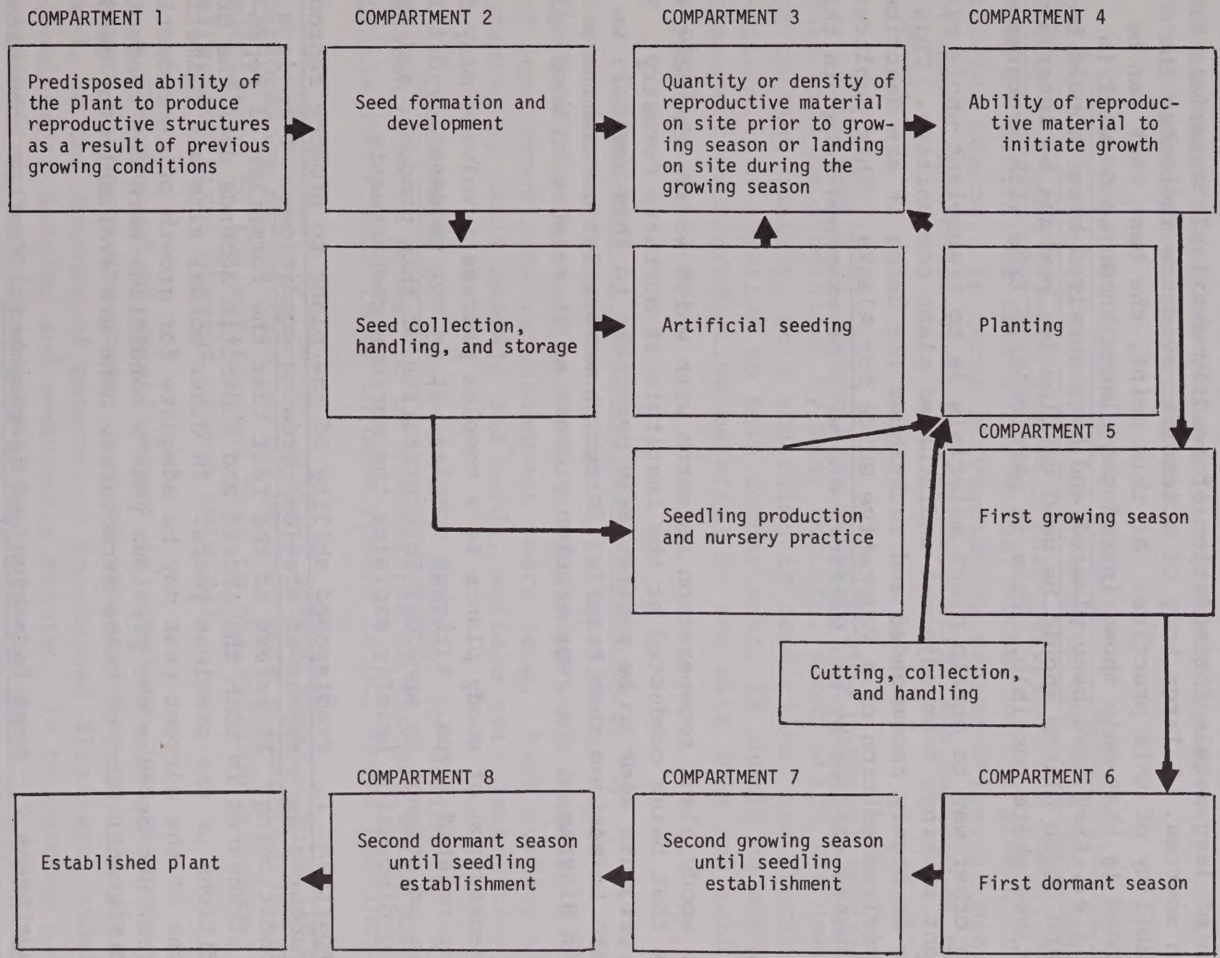


Fig. 1. Schematic representation of the revegetation process for woody plants.

pine, Siberian larch, and Scots pine. These particular exotics are being grown from seed collected from other northern areas. For example, the lodgepole pine seed is from Whitehorse, Yukon Territory, and the Siberian larch and Scots pine are from Finland. The methods being used can be adapted to production of other trees and most shrubs.

The current scarcity of seed and vegetatively reproduced woody plant materials (e.g., seedlings and cuttings) adapted for Alaska raises the question of large-scale introduction of readily available materials from southern sources. A large body of scientific evidence indicates the undesirability of this practice. At this point, the best that can be recommended is that only those introduced plants known to do well in Alaska (i.e., they have been planted and have survived here) should be used. And these plants should be used cautiously; perhaps be intermixed with natives where possible. This is particularly true with evergreens.

The other way to obtain plant materials is to transplant whole plants or dormant cuttings from adjacent undisturbed plant communities. This practice is highly recommended and techniques for using it are described in the revised edition of A Vegetative Guide for Alaska. This publication was discussed earlier by Mr. Clifford and will be examined later in this paper.

Research

The woody plant regeneration research with which we are the most familiar is that being conducted at the Institute of Northern Forestry. Two current projects seem to be particularly pertinent to this seminar; we would like to mention them briefly. First, however, let us examine a schematic diagram of the regeneration process as it relates to woody plants (Fig. 1).

Revegetation of woody plants is a complex process involving many discrete but related steps. Although complex, it is not necessarily difficult. Fig. 1 is an attempt to show our interpretation of this process, and the following discussion briefly explains the various compartments.

Compartment 1. Predisposed ability of the plant to produce reproductive structures as a result of previous growing conditions. This is a form of preconditioning. It refers to the fact that the formation of reproductive structures in both the Arctic and Subarctic depends upon the growing conditions of the previous years. In other words, site and climatic conditions of the current year may be adequate for growth of reproductive structures, but because the previous year's conditions were not conducive to the differentiation of these structures, none are available for seed production.

Compartment 2. Seed formation and development. Weather conditions can reduce or totally prohibit the development of mature seeds. For example, late (e.g., May or June) frosts can destroy entire flower crops. More

subtle but perhaps more important is the effect of cool summers on maturation of the seed crop. Maturation is slowed and the result is seed of low quality because it is anatomically or physiologically immature. This is very common in the Arctic and Subarctic where examples are known for both woody and herbaceous plants.

Artificial regeneration procedures which start with seed as the basic ingredient also depend on conditions in compartments 1 and 2. It is in compartment 2 that these artificial processes branch from the natural events. Artificial regeneration via seed, whether by seeding or planting, makes efficient use of seed resources either by delivering them to suitable sites or by producing seedlings which bypass many of the rigors natural seedlings must withstand.

Compartment 3. Quantity or density of reproductive material on site before the start of growth or delivered to the site and capable of growth during the same growing season. This refers to the number of seeds delivered by natural or artificial means, either before growth or during the growing season. In terms of vegetative reproduction, it means the density of above- and below-ground structures which are capable of producing new plants.

Compartment 4. Ability of reproductive material to initiate growth. This will be determined by many factors, among which are seed, seedling or cutting quality, soil and climatic conditions, and species-site interactions. In relation to this compartment, it should be emphasized that placement of reproductive material on the site does not mean that the project is a success.

Compartment 5. First growing season survival. The first growing season is often the most critical in the life of a plant. At this time, the seedling is susceptible to a number of environmental factors that are of less importance in subsequent years (e.g., high surface temperatures, grazing by small mammals and birds, surface soil desiccation).

Compartment 6. First dormant season. As during the first growing season, plants appear to be susceptible to factors which are of relatively little importance later in development (e.g., frost heaving).

Compartment 7. Second growing season through establishment. Plant performance during this period becomes more a question of the organism's adaptation to the environment than to the relatively ephemeral factors affecting first growing season survival.

The concept of establishment is nebulous, but in woody plants it generally means the point at which the seedling or transplant is thriving and, in the absence of natural or man-caused disasters, at which it will continue to develop and eventually mature. In herbaceous plants, establishment may be linked more closely to the ability simply to maintain itself each year.

Compartment 8. Second dormant season through establishment. The reasoning here is similar to that for the second growing season.

Use of Willows for Revegetation

The first research project which we would like to summarize deals with the use of early successional species to revegetate sites disturbed during construction activities; in other words, those sites where all vegetative cover and organic matter is removed from the site and where the soil frequently is an unweathered subsurface material that has not sustained plant growth. The early successional species such as willow, aspen, balsam poplar, paper birch, alder, and others frequently occur on these sites that are created by man or natural disturbances. These species exhibit rapid initial growth, apparently grow relatively well although soil nutrition is low, provide excellent browse for small and large game, and are difficult to destroy by natural causes once established. In the case of alder, ability to fix atmospheric nitrogen can increase soil fertility (Van Cleve et al. 1971). These features are frequently looked for in plants for reclamation and revegetation projects.

Using the willows as an example, we would like to examine briefly several aspects of their use in revegetation. Willows are commonly regenerated by unrooted, dormant stem cuttings. This method has been used successfully in northern Canada (Dabbs et al. 1974). Although there is little doubt that use of cuttings on a large scale will work in Alaska, it has not been done. One precaution that must be considered is the relative ability of the various species of willows to produce roots on stem cuttings. Exploratory field and laboratory studies indicate that differences exist between species in the ability to produce roots on dormant, untreated cuttings. For example, our experience to date indicates that *S. alaxensis* roots more readily than either *S. scouleriana* or *S. bebbiana*. In addition, we do not know if cuttings will stabilize very unstable areas as rapidly as grasses.

Another means of willow regeneration which has been considered of little importance to date is artificial seeding. The primary reason for this has been the inability to maintain viability of willow seed during storage (Brinkman 1974). Recent research with Alaskan willows has shown, however, that willow seed can be stored for periods of more than one year with little loss of viability (Zasada and Densmore, in press). As with use of cuttings, artificial seeding needs to be tested on an operational scale.

This brief discussion illustrates the potential versatility available with the use of woody plants. That is, different methods of plant establishment are potentially available for individual species as well as a broad range of species. For willow, we know that cuttings and seeding can be used. In addition, planting of rooted seedlings, either collected from natural sites or raised in nurseries, has been successful.

Natural Regeneration

Natural regeneration can be considered for both the highly modified site as described above or for those sites where soil disturbance is minimal and only the existing vegetation is destroyed (e.g., burning, forest harvesting, wildlife rehabilitation). The major type of disturbance which we would like to discuss is that due to harvesting in upland white spruce stands. The main point to be made with regard to regeneration under these conditions is that species composition of the recovering vegetation can be drastically different, depending on the degree of surface disturbance.

Little or no surface disturbance has resulted in regrowth of herbs and shrubs from vegetative parts in the organic layers and surface soil, with almost no invasion of plants via seedling regeneration. In other words, invasion of plants from surrounding unharvested areas is of minimal importance. The processes primarily involved are sprouting and suckering of material on the site before disturbance.

At the other extreme is surface disturbance which is designed to create a mineral soil seedbed. With these surface conditions, regeneration from seed is very important. Removal of the organic layer has eliminated certain species but sprouting of species whose roots and rhizomes are below the disturbed area can be important. In other words, surface disturbance has significantly altered the course of secondary succession on parts of the area, and depending on the land managers' objectives this can have both favorable and unfavorable impacts. Care must be taken in this process as removal of the surface soil layers may reduce nutrient availability.

Revision of "A Vegetative Guide for Alaska"

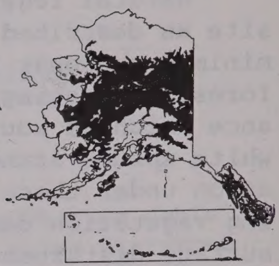
In an attempt to assemble the knowledge available concerning use of woody plants in Alaska we have been involved in a revision of the publication A Vegetative Guide for Alaska." Information on the woody plants is changed drastically in the revised edition. The format follows that used for grasses and provides general instructions regarding establishment of woody plants (e.g., fertilization, methods of establishment for different types of plant material, site preparation, and cultural treatment to enhance growth). Figures 2, 3, and 4 present examples of the plant material recommendations for the Interior Area. The other five areas of the State are treated similarly.

In these tables are recommendations for different soil groups and different methods by which these species can be propagated. In addition, the species have been broken into three height classes. This classification recognizes that the various height classes are potentially important, depending on the goals of the revegetation project.

The woody plant information in this publication makes it easy to

INTERIOR AREA

Trees and Tall Shrubs
[15 feet or more]



SPECIES FOR REVEGETATION		Adapted to Soil Groups	TYPE OF PROPAGATION				Spacing Maximum (feet)
COMMON NAME	*Scientific Name*		Seed	Seedling & Trans-plants	Stem Cuttings	Root Cuttings	
TAMARACK	*Larix laricina*	1,4,5,6	X	X			10 X 10
SIBERIAN LARCH*	*Larix siberica*	1,2	X	X			10 X 10
NORWAY SPRUCE*	*Picea abies*	1,2,4	X	X			10 X 10
WHITE SPRUCE	*Picea glauca*	1,2,4	X	X			10 X 10
BLACK SPRUCE	*Picea mariana*	1,4,5,6	X	X			10 X 10
LODGEPOLE PINE*	*Pinus contorta var. latifolia*	1,2,4					10 X 10
SCOT'S PINE*	*Pinus sylvestris*	1,2	X	X			10 X 10
THINLEAF ALDER	*Alnus tenuifolia*	1,2,4,5	X**	X	X		5 X 5
ALASKA PAPER BIRCH	*Betula papyrifera var. humilis*	1,2,4,5	X	X			8 X 8
BALSAM POPLAR	*Populus balsamifera*	1,2,4	X	X	X**	X	5 X 5
QUAKING ASPEN	*Populus tremuloides*	1,2,3,4	X	X		X	5 X 5
EUROPEAN BIRD CHERRY*	*Prunus padus*	1,2	X	X	X		8 X 8
FELTLEAF WILLOW	*Salix alaxensis*	1,2,4,5	X	X	X**		5 X 5
BEBB WILLOW	*Salix bebbiana*	1,2,4,5	X	X	X**		5 X 5
SCOULAR WILLOW	*Salix scouleriana*	1,2,4,5,6	X	X	X**		5 X 5
EUROPEAN MOUNTAIN ASH	*Sorbus aucuparia*	1,2		X	X		8 X 8

* Exotic
** Recommended Method

Fig. 2. Trees and tall shrubs recommended for the Alaska Interior. (From A Vegetative Guide for Alaska, *revised edition in press.)*

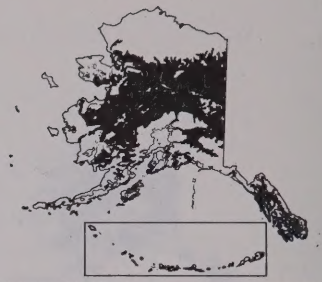
INTERIOR AREA

Intermediate Shrubs
[3-15 feet]

SPECIES FOR REVEGETATION		Adapted to	TYPE OF PROPAGATION				Spacing Maximum
COMMON NAME	*Scientific name*	Soil Groups	Seed	Seedling & Trans-plants	Stem Cuttings	Root Cuttings	(feet)
AMERICAN GREEN ALDER	*Alnus crispa*	1,2,4,5	X*	X			5 X 5
RED-OSIER DOGWOOD	*Cornus stolonifera*	1,4,5	X	X	X*	X	4 X 4
SILVER BERRY	*Elaeagnus commutata*	1,2,3	X	X		X	6 X 6
BUSH CINQUEFOIL	*Potentilla Fruticosa*	1,2,4,5	X	X			4 X 4
PRICKLY ROSE	*Rosa acicularis*	1,2,4,5	X	X	X	X	5 X 5
AMERICAN RED RASPBERRY	*Rubus idaeus var strigosus*	1,2,4	X	X	X	X	3 X 3
LITTLETREE WILLOW	*Salix arbusculoides*	1,4,5	X	X	X*		10 X 10
GRAYLEAF WILLOW	*Salix glauca*	1,4,5	X	X	X*		5 X 5
RICHARDSON WILLOW	*Salix lanata ssp. richardsonii*	1,4,5	X	X	X*		4 X 4
DIAMONDLEAF WILLOW	*Salix planifolia ssp. pulchra*	4,5,6	X	X	X*		6 X 6
BUFFALOBERRY	*Sherpherdia canadensis*	1,2	X	X			5 X 5
GREENE MOUNTAIN ASH	*Sorbus scopulina*	1,2,4		X	X		8 X 8
BEAUVERO SPIREA	*Spiraea beauverdiana*	1,4,5,6	X	X	X		4 X 4
HIGH BUSH CRANBERRY	*Viburnum edule*	1,2,4	X	X	X		4 X 4

* Recommended Method

Fig. 3. Intermediate shrubs recommended for the Alaska Interior. (From A Vegetative Guide for Alaska, *revised edition in press.)*



INTERIOR AREA

Groundcovers
[3 feet or less]

SPECIES FOR REVEGETATION		Adapted to Soil Groups	TYPE OF PROPAGATION				Spacing Maximum (feet)
COMMON NAME	*Scientific name*		Seed	Seedling & Trans-plants	Stem Cuttings	Root Cuttings	
COMMON JUNIPER	*Juniperus communis nana*	1,2,3	X	X			6 X 6
CREEPING JUNIPER	*Juniperus horizontalis*	1,2,3	X	X			5 X 5
WAUKEGAN JUNIPER*	*Juniperus horizontalis douglasi*	1,2,3		X			5 X 5
ANDORRA JUNIPER*	*Juniperus horizontalis plumosa*	1,2,3		X			5 X 5
FLAT CREEPING JUNIPER*	*Juniperus horizontalis procumbens*	1,2,3		X			5 X 5
DWARF MUGO PINE*	*Pinus mugo mughus pumilo*	1,2,3		X			3 X 3
BOG-ROSEMARY	*Andromeda polifolia*	4,5,6	X	X			2 X 2
ALPINE BEARBERRY	*Arctostaphylos alpina*	1,2,3	X		X		1 X 1
RED-FRUIT BEARBERRY	*Arctostaphylos rubra*	1,2,3,4	X		X		1 X 1
BEARBERRY	*Arctostaphylos uva-ursi*	1,2,3	X		X		3 X 3
ALASKA SAGEBRUSH	*Artemisia alaskana*	1,2,3	X	X	X		2 X 2
FRINGED SAGEBRUSH	*Artemisia frigida*	1,2,3	X	X	X		2 X 2
DWARF ARCTIC BIRCH	*Betula nana*	1,2,4,5	X	X			5 X 5
LEATHERLEAF	*Chamaedaphne calyculata*	4,5,6	X				3 X 3
BUNCHBERRY	*Cornus canadensis*	1,2,4	X	X**		X	1 X 1
CROWBERRY	*Empetrum nigram*	1,2,4,5	X	X	X***		2 X 2
NARROW-LEAF LABRADOR-TEA	*Ledum decumbens*	4,5,6	X	X			3 X 3
LABRADOR-TEA	*Ledum groenlandicum*	4,5	X	X			4 X 4
SWEETGALE	*Myrica gale*	4,5,6	X	X			6 X 6
LAPLAND ROSEBAY	*Rhododendron lapponicum*	1,2,4,5	X	X	X		2 X 2
AMERICAN RED CURRANT	*Ribes triste*	1,2,4	X	X	X		2 X 2
NAGOON-BERRY	*Rubus arcticus*	1,4,5,6	X	X		X	1 X 1
CLOUDBERRY	*Rubus chamaemorus*	1,4,5,6	X	X			1 X 1
ALASKA BOG WILLOW	*Salix fuscesens*	4,5,6	X	X	X***		1 X 1
NETLEAF WILLOW	*Salix reticulata*	1,2,4,5	X	X	X***		1 X 1
INDIAN SNOWBERRY*	*Symphoricarpas orbiculatus*	1,2,3,4	X	X		X	1 X 1
BOG BLUEBERRY	*Vaccinium uliginosum*	1,2,4,5	X	X	X		2 X 2
LINGONBERRY	*Vaccinium vitis-idaea*	1,2,4,5	X	X**			1 X 1

* Exotic   ** Sod Method   *** Recommended Method

Fig. 4. Ground covers recommended for the Alaska Interior. (From A Vegetative Guide for Alaska, *revised edition in press.)*

compare them with nonwoody plants, which are currently used almost exclusively in revegetation in Alaska.

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summary

This was a successful effort at getting people together to talk about problems of preventing surface destruction on public lands in Alaska, but if you will pardon the pun, we have hardly scratched the surface of the subject. This week we have had an overview of many aspects of the problem, and I think that we can see the need to treat specific types of uses and disturbances in future seminars.

Curt McVee spoke of the need to develop standards and procedures to prevent excessive surface disturbances by vehicles traveling away from roads, and he said that among those results we hoped to come from this seminar were:

1. a comprehensive set of "guide specifications" which could be used to cover the spectrum of situations arising in Alaska;

2. eventual agreement and continuity among agencies in issuing permits for travel and transportation across public lands;

3. suggested research needs for development of methods, practices, and equipment to prevent surface damages in the future.

We heard that there are double standards, maybe even triple standards, for users of National Resource Lands administered by BLM because of the application of diverse laws, and the lack of a unifying Organic Act for the agency. In many cases BLM can do little to prevent damage, and must take action after the fact.

On the other hand, we were told how the Forest Service has a firm body of laws and regulations which control access, use, and damage on National Forests. Similarly, the Fish and Wildlife Service has enforceable regulations controlling use of the National Wildlife Refuges. The oilfield on the Kenai Moose Range may well be a model for the rest of us to emulate.

Jerry Brown told us that he thinks we in Alaska have gone through the period of conquering nature in the Arctic, and that now we should design with nature. My personal feeling is that his statement may well be the keynote statement, or theme, for another seminar.

Stan Specht and several other speakers showed us examples of how we could design with nature and cause the hand of man to rest lightly upon the landscape, but many speakers showed examples of the too many insensitive and ignorant acts which will leave scars long after their perpetrators are dead.

We certainly do not have a meeting of the minds on the subject of this seminar. Speakers from the Bureau of Mines, the mining industry, and the oil and gas industry do not admit to seeing any surface disturbance problems or any need for further regulations or permits. They told us that there are now too many regulations governing their activities, used the specious arguments about minute percentages of the earth's surface being affected by those activities, and proceeded to wrap themselves in the cloak of free enterprise. Heaven preserve us from any more of the old unrestrained enterprise! With a rising population and a dwindling supply of land, we can no longer afford private actions which are contrary to the long-term public good.

One of the reasons for this seminar was that the public concern has been vigorously expressed to BLM about certain unrestrained activities associated with mineral development. John Stephenson characterized many of those damages as being caused by "gypo-miners" and that may be an apt description.

Several speakers have pointed out the need for educating users to potential damages and possible preventive measures they could take. That will require more time and manpower on BLM's part, and so will the obvious need for more supervision and surveillance in the field, not just of the major projects, but of all potentially hazardous activities. Joe Ebner mentioned that "gentleman's agreements" do not work to prevent damage or assure repair once the damage is done.

Examples from developments on National Forests and National Wildlife Refuges show clearly that when a management agency has clear enforcement authority, uses proper permit stipulations, and practices good field surveillance, industry can do a good job of which everyone can be proud.

The notable characteristic of the panel discussion Wednesday afternoon was the way half a dozen government administrators passed around the hot potatoes! John Hall did an excellent job as moderator, but even with more time, we would not have gotten defin-

itive answers to some of the questions asked of the panel members. With two or three agencies either claiming overlapping authority or denying all responsibility, it is no wonder that John Q. Public is confused.

It seems that we are going to have to agree on some basic definitions. Various speakers preferred rehabilitation, restoration, revegetation, or some other term when speaking of repairing damages.

And there still remain two big questions to answer:

1. How do we measure impact so that we can agree that there is impact?

2. How do we measure restoration or rehabilitation so that we can agree that it has been accomplished?

In the past, patching up after the fact was an acceptable way of doing business, and the present state of the art still gives us more ability to repair damage than to prevent it. Philosophies and laws have changed since 1970 with the implementation of the National Environmental Policy Act and other legislation aimed at preserving the quality of the human environment. Now it is necessary that we be assured that a proposed action will not have an adverse impact, and that all possible alternatives are considered to prevent a deterioration of the quality of life for man and beast.

It is also the goal of those of us within BLM to manage and protect the National Resource Lands in Alaska in order to provide for continuing public benefits into the future. We will appreciate your continued interest and comments on the topics covered in this seminar.

--Dr. H. William Gabriel